# Acterna FST-2310 TestPad

## SONET Services Module

User's Guide

ACTERNA™
The Keepers of Communications

# Acterna FST-2310 TestPad

## SONET Services Module

User's Guide

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This guide is a product of Acterna's Technical Information Development Department, issued as part of the *FST-2310 TestPad User's Guide* . The ordering number for a published guide is ML-2310.

***Federal Communications Commission (FCC) Notice***

This product was tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This product generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this product in a residential area is likely to cause harmful interference, in which case you will be required to correct the interference at your own expense.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The authority to operate this product is conditioned by the requirements that no modifications be made to the equipment unless the changes or modifications are expressly approved by Acterna.

***Industry Canada Requirements***

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

***EMC Directive Compliance***

This product was tested and conforms to the EMC Directive, 89/336/EEC as amended by 92/31/EEC and 93/68/EEC for electromagnetic compatibility. A copy of the Declaration of Conformity is provided with this manual.

Warning: This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures. In order to maintain EMC compliance, use shielded cables when connecting to the electrical ports (DS1 and DS3/STS-1).

***Low Voltage Directive Compliance***

This product was tested and conforms to the Low Voltage Directive, 73/23/EEC as amended by 93/68/EEC. Conformity with this directive is based upon compliance with the harmonized safety standard, EN60950. A copy of the Declaration of Conformity is provided with this manual.

# Declaration of Conformity

ACTERNA

**Application of Council Directive(s):**

LVD: 73/23/EEC as amended by 93/68/EEC
EMC: 89/336/EEC as amended by 92/31/EEC and 93/68/EEC

**Standard(s) to which Conformity is Declared:**

EN60950 (A1-A4 & A11), EN55022:1998, EN55024:1998, EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6, EN61000-4-11, EN61000-3-2, and EN61000-3-3

**Manufacturer:** Acterna
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Germantown, MD 20876
USA

**EU Address:** Acterna LLC through its subsidiary at:
Portland House
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Berkshire
RG7 4HR
United Kingdom

| **Model No.:** | **Product Description:** |
|---|---|
| 2310 | TestPad 2000™ SONET Field Services Module |
| FST-2310 | TestPad SONET Services Module |

***I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s).***

Germantown, MD USA

29 October, 2002
Date

John Paul Williams
Signature

John Paul Williams
Print Name

Senior Director of Quality, Reliability, and EH & S
Print Title

Acterna Doc. No. 50-17316-01 Rev. D

# Important Safety Instructions

The following table defines safety terms. Failure to observe these precautions while using the FST-2310, violates the intended use of this product.

*Safety definitions*

| Term | Description |
|---|---|
| DANGER | Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. |
| WARNING | Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. |
| CAUTION | Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices. |

When using this product, always follow basic safety precautions to reduce the risk of fire, shock, and injury to persons. Basic safety precautions are as follows:

1. Read and follow all warning notices and instructions marked on the product and included in the manual.
2. Use only the AC Adapter/Charger supplied with the product.
3. Do not use AC Adapter/Charger outdoors or in wet or damp locations.
4. Connect the AC Adapter/Charger to the correct mains voltage, as indicated on the ratings label.
5. Do not allow anything to rest on the power cord, and do not locate the product where people can walk on the power cord.
6. Avoid using this product during an electrical storm. There may be a remote risk of electric shock from lightning.
7. Do not use this product in the vicinity of a gas leak or in any explosive environment.
8. Do not attempt to service this product yourself, as opening or removing covers may expose you to dangerous, high voltage points and other hazards. Contact qualified service personnel for all service.

9 **CAUTION:** Danger of explosion if battery is incorrectly replaced. Replace only with (part number 11-18066). Dispose of used batteries according to the manufacturer's instructions.

10 **CAUTION:** Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

11 **CAUTION:** The FST-2310 with OC-3/OC-12/OC-48 is a Class 1 laser product.

## Save these instructions

### Symbols

The following safety symbol is used on the FST-2310. All safety precautions must be observed when operating, servicing, or repairing the FST-2310. Failure to comply with the following safety precautions or with hazard cautions and warnings used throughout this manual violates the intended use of this instrument.

**GENERAL HAZARD**

This icon represents a general warning or caution.

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# About This Guide

The topics discussed in this section are as follows:


- "Purpose and scope" on page xx
- "Assumptions" on page xx
- "Related information" on page xx
- "Technical assistance" on page xxi
- "Conventions" on page xxii

## Purpose and scope

The purpose of this guide is to help you successfully use the FST-2310 TestPad features and capabilities. This guide includes task-based instructions that describe how to install, configure, use, and troubleshoot the FST-2310 TestPad. Additionally, this guide provides a complete description of Acterna's warranty, services, and repair information, including terms and conditions of the licensing agreement.

## Assumptions

This guide is intended for novice, intermediate, and experienced users who want to use the FST-2310 TestPad effectively and efficiently. We are assuming that you have basic computer, mouse/track ball, and networking experience and are familiar with basic telecommunication concepts and terminology.

## Related information

Use this guide in conjunction with the following information:

- *The FST-2310 TestPad Remote Control Reference Guide*
- *The FST-2310 Help system*

## Technical assistance

If you need assistance or have questions related to the use of this product, call or e-mail Acterna's Technical Assistance Center for customer support.

**Table 1** Technical assistance centers

| Region | Phone Number | |
|---|---|---|
| Americas | 1-866-ACTERNA<br>301-353-1550 | (1-866-228-3762)<br>tac@acterna.com |
| Brazil | 0800-7015370<br>4617 3839<br>4617 3729 | |
| All others | 1-866-ACTERNA<br>1-866-228-3762 | (1-866-228-3762)<br>tac@acterna.com |
| Europe, Africa, and Mid-East | +800 882 85822<br>(European Freephone) | support.uk@acterna.com |
| | (Acterna UK) | support.uk@acterna.com |
| | +49 (0) 6172 59 11 00<br>(Acterna Germany) | hotline.germany@acterna.com |
| | +33 (0) 1 39 30 24 24<br>(Acterna France) | hotline.germany@acterna.com |
| Asia and the Pacific | +852 2892 0990<br>(Hong Kong) | |
| | +8610 6833 7477<br>(Beijing-China) | |
| Australia | +61 3 9690 6700 | |

During off-hours, you can request assistance by doing one of the following: leave a voice mail message at the Technical Assistance number in your region; e-mail North American Technical Assistance

Center, tac@acterna.com, or European Technical Assistance Center, support.uk@acterna.com; or submit your question using our online Technical Assistance Request form at www.acterna.com.

## Conventions

This guide uses naming conventions and symbols, as described in the following tables.

**Table 2** Typographical conventions

| Description | Example |
|---|---|
| User interface actions appear in this **typeface**. | On the Status bar, click **Start**. |
| Buttons or switches that you press on a unit appear in this **Typeface**. | Press the **On** switch. |
| Code and output messages appear in this `typeface`. | `All results OK` |
| Text you must type exactly as shown appears in this **`typeface`**. | Type: **`a:\set.exe`** in the dialog box. |
| Variables appear in this *typeface*. | Type the new *hostname*. |
| Book references appear in this *typeface*. | Refer to *Newton's Telecom Dictionary* |
| A vertical bar \| means "or": only one option can appear in a single command. | `platform [a\|b\|e]` |
| Square brackets [ ] indicate an optional argument. | `login [platform name]` |
| Slanted brackets < > group required arguments. | `<password>` |

**Table 3** Keyboard and menu conventions

| Description | Example |
|---|---|
| A plus sign + indicates simultaneous keystrokes. | Press **Ctrl+s** |

**Table 3** Keyboard and menu conventions (Continued)

| Description | Example |
|---|---|
| A comma indicates consecutive key strokes. | Press **Alt+f,s** |
| A slanted bracket indicates choosing a submenu from menu. | On the menu bar, click **Start > Program Files**. |

**Table 4** Symbol conventions

This symbol represents a general hazard.

This symbol represents a risk of electrical shock.

**NOTE:**

This symbol represents a Note indicating related information or tip.

**Table 5** Safety definitions

**WARNING:**

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

**CAUTION:**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

# FST-2310 TestPad Overview

1

This chapter provides a general description of the FST-2310 TestPad. Topics discussed in this chapter include the following:


- "About the FST-2310 TestPad" on page 2
- "What's new" on page 2
- "Features and capabilities" on page 3
- "Configurations and options" on page 4
- "Accessories" on page 7
- "Exploring the FST-2310" on page 11
- "Powering the TestPad" on page 14
- "Navigating the user interface" on page 15

## About the FST-2310 TestPad

The FST-2310 TestPad SONET Services Module is the ideal telecommunications solution for testing OC-48/12/3, STM-16c/4c/1, STS-1 and DS3/1. The FST-2310 is optimized for field use because it is portable and easy-to-use. As a member of the Acterna TestPad 2000 family of products, the FST-2310 has an easy-to-use touch screen user interface that simplifies test setup and reduces test configuration time. The "smart tester" icon-driven interface is easy to learn, and the large display screen provides ample space for viewing test results.

The following items ship with the FST-2310:

- FST-2000 user interface module (UIM)—The user interface module ships with a VGA display (part number 2000-V6), a battery, and an AC adapter, which you use to supply power to the TestPad.
- FST-2310 application module—The application module connects to the UIM, allowing you to test OC-48/12/3, STM-16c/4c/1, STS-1 and DS3/1 rates.
- Y cable—The Y cable connects to the USB/Serial port, enabling you to connect USB and serial devices to the FST-2310.
- User documentation—The FST-2310 comes with a User's Guide, Remote Control Reference Guide, and a comprehensive help system.

## What's new

The FST-2310 is a significant enhancement over previous TestPads. The primary changes are as follows:

- New user interface module—The FST-2310 uses the Acterna FST-2000 TestPad Version 6, which runs under the Windows XP operating system. The FST-2000 TestPad provides a variety of connectivity tools which make installation and troubleshooting more efficient. Options and accessories are also available which allow you to establish network connections to the TestPad, use the TestPad to access a local Web browser, or emulate a VT-100 terminal.

- FST-2310 Help—Comprehensive help topics provide instructions for connecting the FST-2310 to a circuit, testing the circuit, and viewing test results. You can also view test result descriptions and glossary terms in the help system.

## Features and capabilities

The FST-2310 provides you with the tools you need to provision DS1 to OC/48c or STM-16c service, verify end-to-end network performance, and perform network analysis under simulated abnormal conditions.

Features and capabilities of the FST-2310 include the following:

- DS1, DS3, SONET, and SDH interfaces—The FST-2310 is available in seven configurations which offer interfaces for DS1, DS3, and SONET testing. You can also purchase the SDH Analysis option to test STM signals from the optical interface.
- Dual receive for DS1, DS3 and STS-1—The FST-2310 provides dual receivers for DS1. If you purchase the DS3 or STS-1 configuration with a dual receive option, the FST-2310 provides dual receivers for the corresponding rate.
- Monitor/Thru, Terminate, and Drop and Insert tests—You can perform these tests for each rate available on the FST-2310.
- BERT patterns—You can transmit BERT patterns for each rate available on the FST-2310.
- Frame types—The FST-2310 supports a variety of frame types for DS1, DS3, SONET, and SDH rates. For the specific frame types supported for each rate, refer to the associated testing chapter in this guide.
- Error and alarm insertion—You can insert a variety of errors into traffic, such as frame, BPV, and logic errors. For the specific errors available for each rate, refer to the associated testing chapter in this guide.
- Print capability—You can print test configurations and test results using the FST-2310. You can generate a print file at timed intervals or whenever a test ends. You can also manually print test configurations, test results, and histograms at any time.

- View Portable Document Format (PDF) files—You can launch and view PDFs on the TestPad.
- Command line remote control—You can configure the TestPad and perform tests from a remote PC or laptop by issuing remote control commands.
- FST-2310 Help—You can display FST-2310 Help which includes detailed instructions for configuring and performing tests, comprehensive result descriptions, and a glossary of terms.
- Remote GUI—You can use the Remote GUI to run the TestPad GUI from any remote device with a Web browser, such as a PC or laptop. When viewing the GUI from a remote device, you can configure and perform tests, view test results, and do anything you could do using the FST-2310 itself.
- VNC Viewer—You can launch the Virtual Network Computing (VNC) viewer to run remote applications from the FST-2310.

## Configurations and options

When you order a FST-2310, you order a base configuration which allows you to test specific rates. You can also purchase options for the FST-2000 and the FST-2310 which allow you to launch a Web browser, emulate a VT-100 terminal, run the GUI from a remote device, automate tests using test scripts, or expand your testing capabilities.

Table 1 lists each of the FST-2310 configurations.

**Table 1** FST-2310 configurations

| Configuration | Part Number | Allows you to test: |
|---|---|---|
| DS1 | TB2310-P4 | DS1 |
| DS3 | TB2310-P5 | DS3 and DS1 |
| STS-1 | TB2310-P1 | STS-1 and DS1 |
| OC-3 | TB2310-P2 | OC-3, DS3/STS-1, and DS1 |
| OC-12 | TB2310-P3 | OC-12, OC-3, DS3/STS-1, and DS1 |

**Table 1** FST-2310 configurations

| Configuration | Part Number | Allows you to test: |
|---|---|---|
| OC-48 (single wavelength) | TB2310-P6 | OC-48, OC-12, OC-3, DS3/STS-1, and DS1. A 1310nm transmit jack is standard with this configuration. |
| OC-48D (dual wavelength) | TB2310-P7 | OC-48, OC-12, OC-3, DS3/STS-1, and DS1. 1310nm and 1550nm transmit jacks are standard with this configuration. |

## FST-2000 TestPad options

The features provided by FST-2000 TestPad options are available for any application module you attach to the TestPad.

The FST-2000 TestPad offers the following options:

- Web browser (part number 2000-WEB)—Using this option, you can launch a Web browser on the FST-2310 to access information on the Internet or your company's intranet.
- VT100 emulation (part number 2000-VT100)—Using this option, the FST-2310 can emulate a VT100 terminal. This option includes a DB-9 Female to DB-9 Male cable, enabling you to establish a serial connection for VT100 emulation.
- Scripting (part number 2000-SCR)—Using this option, you can write your own test scripts using the Tcl/Tk scripting language to automate and standardize your testing processes.
- Networking (part number 2000-NET)—Using this option, you can establish network connections to the FST-2310 for a variety of applications.

## FST-2310 options

The FST-2310 offers the following application module options:

- Synchronous Digital Hierarchy Analysis (part number TB2310-SDH)—Using this option, you can perform bulk payload testing on STM-1, STM-4c, and STM-16c Synchronous Digital Hierarchy (SDH) signals from the optical interface. The option enables you to monitor performance, perform BER tests, and measure optical power for each of the signals.

- Primary Rate ISDN Analysis (part number TB2310-PRI)—Using this option, you can test Primary Rate ISDN for DS1, DS3, and STS-1. The option allows you to place and receive multiple voice/data calls, perform D channel backup, support NFAS, and monitor the circuit via D channel decodes. It also supports AT&T 5ESS, NT DMS100 and NI-2 call controls, as well as multiple call types such as voice, 56K, 64K, Nx64, Nx56, and H0.
- GR-303 Analysis (part number TB2310-GR303)—Using this option, you can verify the connectivity of the TMC/CSC and EOC management channels, trace calls, and verify report-call setup and teardown information.
- Advanced Stress Patterns (part number TB2310-ASP)—Using this option, you can transmit and receive fixed, long patterns beyond the standard patterns offered in the test set. The seven T1 stress patterns provided with this option are designed to stress test the timing recovery circuits and span-line repeater ALBO circuitry. The patterns include: T1-DALY, 55 octet, 2-96, 3-54, 4-120, 5-53, and MIN/MAX.
- Fractional T1 Analysis (part number TB2310-FT1)—Using this option, you can use FT1 modes for contiguous and non contiguous, 56KxN and 64KxN, and FT1 tests. The option enables you to completely qualify and test new FT1 circuits before connecting customer premises equipment. A V.54 FT1 loop code is available which enables you to perform a single-set test of FT1 circuits from a convenient T1 or DS3 access point.
- DDS Analysis (part number TB2310-DDS)—Using this option, you can use T1 DDS modes for 56K and 64K DDS circuits. It enables you to completely qualify and test new DDS circuits using the DDS1-6, 63, 511 and 2047 stress patterns. The OCU, DSO-DP, CSU, and Channel loop codes enable you to perform single-set tests of DDS circuits from a convenient T1 access point.
- Signaling Analysis (part number TB2310-SIG)—Using this option, you can test the ability of a switch/PBX to handle incoming calls. The option also enables you to emulate switch-to-switch communications. You can place, receive, and monitor calls over several trunk types, and you can send and receive DTMF/MF/DP digits to and from switches and PBXs. It also enables you to measure inter-digit delay and digit/tone duration.
- VF PCM TIMS Analysis (part number TB2310-VF)—Using this option, you can perform a frequency sweep test to qualify VF circuits. This option enables you to measure noise, including SNR,

C-Message, C-Notch, 3k-Flat, and 3k-Notch. Voice Drop, variable tone, level insertion, and level frequency results are standard with the SONET Services Module.

- Intelligent Line Equipment Analysis (part number TB2310-ILE)—Using this option, you can loop up and loop down individual T1 addressable office repeaters, line repeaters, and transmit maintenance switch commands. Additionally, you can loop up and loop down HDSL line units, doublers, and remote units. This option supports T1 equipment manufactured by Teltrend, Westell, and XEL. The option also supports HDSL equipment manufactured by Adtran and PairGain.
- ATM Analysis (part numbers TB2310-ATM-DS3, TB2310-ATM-DS13, TB2310-ATM-OC3 and TB2310-ATM-OC12)—These options are available for DS3 or higher rate units. Using these options, you can test DS1, DS3, OC-3c and OC-12c ATM functionality. Each of these options enable you to transmit and receive ATM cell streams with different VPI/VCI addresses, and measure ATM QoS parameters such as dropped cells, mis-inserted cells, and out-of-sequence cells. The options automatically identify multiple cell streams on an ATM circuit, enabling you to completely qualify and test new ATM circuits before connecting customer premises equipment and/or network elements.
- Scripting Library(part number 2000-LIB)—A scripting library is currently under development. Using this option, you will be able to run a variety of automated test scripts developed by Acterna.

## Accessories

You can also purchase accessories for the FST-2310 which allow you to establish remote connections, print information, and connect devices to the TestPad. To order accessories for the FST-2310, contact Acterna Customer Care.

## Connectivity accessories

Table 2 lists the accessories available for establishing remote connections.

**Table 2** Connectivity accessories

| Accessory | Part Number | Used to ... |
|---|---|---|
| DB-9 Female to DB-9 Female null modem cable | CB-014491 | Connect a laptop to the serial connector of the Y cable. Typically used for remote control command operation. |
| Serial PCMCIA card | 2000-SERIAL | Provide a second serial connection to the TestPad. This allows you to connect two serial devices to the TestPad—one to the serial connector of the Y cable, and one to the connector provided on the serial PCMCIA card. |
| Analog dial-up modem PCMCIA card | 2000-ANLG-MODEM | Establish an analog dial-up connection to the TestPad. Ships with an RJ-11 phone cable. |
| RJ-11 phone cable (replacement) | CB-834011 | Connect an Analog Dial-Up Modem PCMCIA card to a phone jack. |
| Ethernet 10/100 Base-T LAN PCMCIA card | 2000-LAN | Establish an Ethernet connection from the TestPad to a laptop or LAN.<br>– Ships with an Ethernet LAN cable for LAN connections (replacement cables can be ordered if necessary).<br>– Laptop connections require an Ethernet cross-over cable (part number CB-834251). |
| Ethernet LAN cable (replacement) | CB-016267 | Connect an Ethernet PCMCIA card in the TestPad to an Ethernet jack. |

**Table 2** Connectivity accessories (Continued)

| Accessory | Part Number | Used to ... |
|---|---|---|
| 802.11b Wireless LAN PCMCIA card | 2000-WLAN | Establish an 802.11 wireless connection to the TestPad. |
| Bluetooth Wireless PCMCIA card | 2000-BT-MODEM | Establish a Bluetooth wireless connection to the TestPad. |
| USB Direct Connect cable | CB-18944 | Establish a direct USB connection from the TestPad to a laptop via the USB connector on the Y cable. |
| Ethernet cross-over cable (6 ft.) | CB-834251 | Connect a PCMCIA Ethernet card in the TestPad to a laptop. |
| Y cable (replacement) | CB-45570 | Connect to the USB/Serial port, enabling you to connect serial and USB devices to the TestPad. |

## Print accessories

Table 3 lists the available print accessories.

**Table 3** Print accessories

| Accessory | Part Number | Used to ... |
|---|---|---|
| Serial Printer | PR-40B | Print test configurations, test results, and histograms from the TestPad.<br>– Requires DB-9 Female to DB-9 Male cable (part number: CB-018179) to connect to the TestPad. |
| DB-9 Female to DB-9 Male cable | CB-018179 | Connect a PR-40B printer to the serial connector of the Y cable. |

**Table 3** Print accessories (Continued)

| Accessory | Part Number | Used to ... |
|---|---|---|
| DB-9 Female to DB-25 Male Cable | CB-45766 | Connect a PR-40A printer to the serial connector of the Y cable.<br>NOTE: The PR-40A printer is no longer available for purchase. |
| USB Printer | 2000-USB-PRINTER | Print test configurations, test results, and histograms from the TestPad. The USB Printer connects to the USB connector on the Y cable via a cable (supplied with the printer). |

## Additional accessories

Table 4 lists additional accessories available for the FST-2310.

**Table 4** Additional accessories

| Accessory | Part Number | Connects to ... |
|---|---|---|
| USB Portable Keyboard | 2000-USB-KEYBRD | The USB connector of the Y cable. |
| USB Mouse | 2000-USB-MOUSE | The USB connector of the Y cable. |
| USB Hub | 2000-USB-HUB | The USB connector of the Y cable. Connecting a USB hub enables you to connect multiple USB devices to the TestPad simultaneously. |
| 2.5mm Headset | 2000-HEADSET | The Headset jack on the bottom panel of the Test-Pad. |
| ATA PCMCIA Storage Card | 2000-STORAGE | The top or bottom PCMCIA card slot on the TestPad. |

## Exploring the FST-2310

The following sections introduce you to the top, bottom, front, and LED display panels of the FST-2310.

### Top panel

The top panel provides the USB/Serial port, dual PCMCIA card slot, and test connectors. See Figure 1.

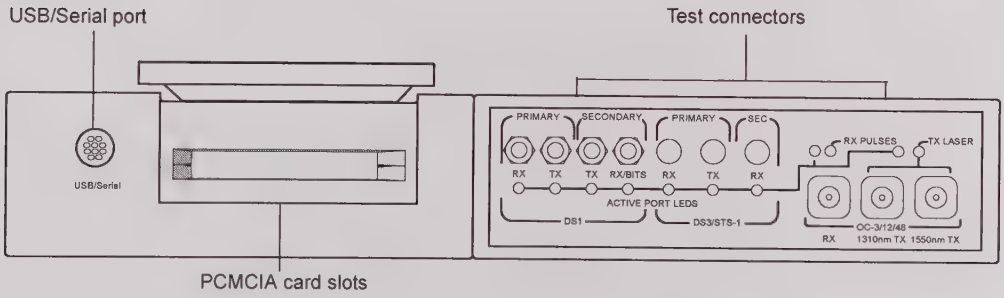



**Figure 1** FST-2310 top panel

***USB/Serial port***

The USB/Serial port provides a 10-pin connector for the Y cable. By attaching the Y cable shipped with the FST-2310 (see Figure 2 on page 12), you can connect serial devices such as a printer, laptop, or PC, and USB devices, such as a keyboard, mouse, printer, or hub to the TestPad. The serial connector of the Y cable is configured as a Data Terminal Equipment (DTE) connector; the USB port is configured as a USB host.

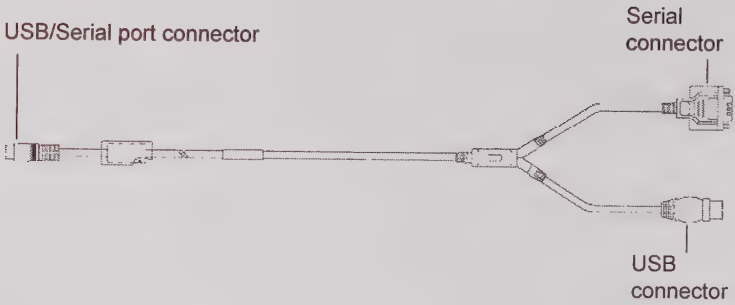



**Figure 2** Y cable

To connect serial and USB devices to the TestPad, first connect the Y cable to the TestPad. If you are connecting USB devices such as a mouse, keyboard, hub, or printer, you connect the device directly to the USB connector of the Y cable. If you are connecting a serial device, you connect an intermediate cable to the Y cable, and then connect the other end of the cable to the device.

For descriptions of each of the intermediate cables, see Table 2 on page 8 and Table 3 on page 9.

***PCMCIA card slots***

Two PCMCIA card slots are provided on the TestPad. PCMCIA cards are available for the TestPad which allow you to establish modem, wireless, Ethernet, or serial connections to the TestPad and store test configurations, test results, and print files.

Ethernet LAN, Ethernet cross-over, and some serial cables are also attached to associated PCMCIA cards which are inserted in the Test-Pad.

For descriptions of each of the connectivity cards offered as an accessory by Acterna, see Table 2 on page 8.

## Bottom panel

The bottom panel provides the battery access panel, headset jack, DC IN jack (used with the AC adapter to power the TestPad), and the power switch. See Figure 3.

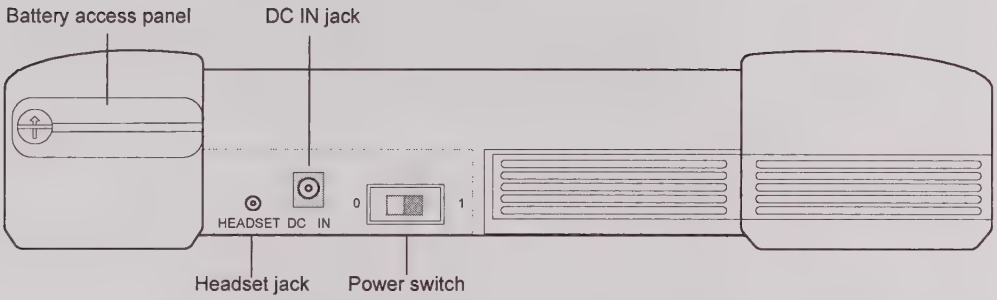



**Figure 3** FST-2310 bottom panel

## Front panel

The front panel provides a touch-sensitive LCD screen that displays the user interface. The user interface allows you to set up the TestPad, configure tests, and display test results (see "Navigating the user interface" on page 15). The power LEDs, status LEDs, speaker, and microphone are also located on the front panel. See Figure 4.I

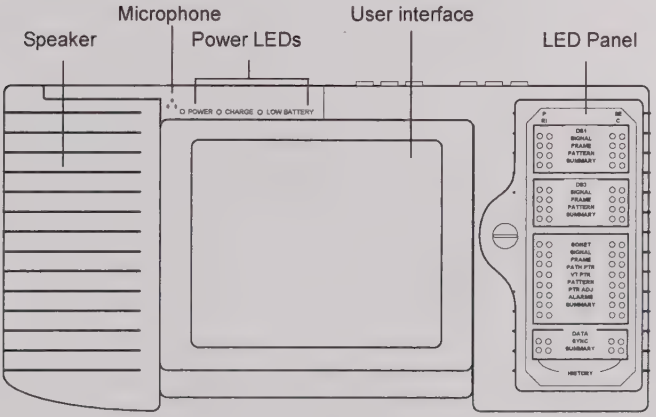



**Figure 4** FST-2310 front panel

### LED display panel

The LED display panel shows the current and historical Status and Alarm LEDs. The inside column of LEDs indicates the current condition or state of the signal; the outside column of LEDs indicates the historical condition of the signal. See Figure 5.

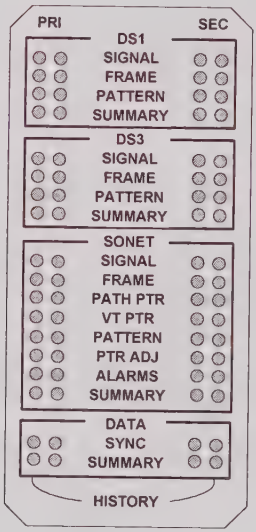



**Figure 5** LED display panel

For a detailed description of each LED, see Chapter 11 "Test Results".

## Powering the TestPad

Power is supplied to the FST-2310 by the battery or the AC power adaptor. To supply power using the adaptor, plug the adaptor into the DC IN jack located on the bottom panel of the FST-2310. For power specifications see "Electrical specifications" on page 285.

**WARNING:**

RISK OF DAMAGE TO UNIT. Do not use the adapter supplied with the Acterna FST-2000 User Interface Module (UIM) with older UIMs labeled TTC 2000 or TestPad 2000. Do not use the adapter supplied with older UIMs with the Acterna FST-2000 UIM.

**To power the TestPad**

– Turn the power switch to the ON position.

The Power LED, located on the front panel, illuminates green when the TestPad is powered.

## Navigating the user interface

The user interface lets you set up the TestPad, configure tests, and display test results. The touch-sensitive screen is divided into separate areas for TestPad set up, test configuration, and test results.

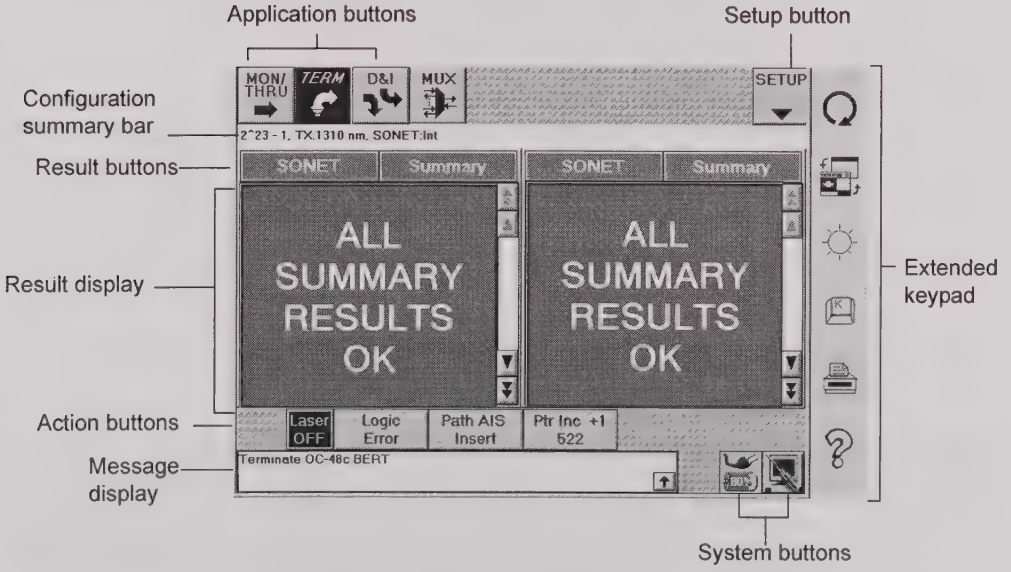



**Figure 6** FST-2310 user interface

**NOTE:**

We recommend using the stylus supplied with the TestPad to activate functions on the touch-sensitive screen.

**Application buttons** The application buttons, located on the upper-left corner of the window, provide quick access to each test. The buttons are organized by operating mode, rate, payload (if applicable), and then test.

**Setup button** The Setup button provides access to tabs for configuring your tests. After you select the operating mode, rate, payload (if applicable), and application for a test, you select the Setup button to configure the test. For details on configuring a test, see "Step 1: Configuring a test" on page 86.

**Configuration summary bar** The configuration summary bar displays the current test and the configuration settings for the test.

**Result buttons** In each result pane there is a Result Group and Result Category button. The Result Group button allows you to set each result pane to view different test rates, if applicable. The Result Category button allows you to set the results category for the pane. By selecting a different group or category for each pane, you can view two sets of results at the same time.

**Result display** The test results for the TestPad appear in the result display.

**Action buttons** The action buttons are located above the message display. The action buttons perform additional functions specific to the application you select. A different set of action buttons appears each time you select a mode of operation. For example, if you configure the TestPad for an optical test, the Laser On/Off action button appears, enabling you to turn the laser on and off. The buttons may or may not be active depending on the application you select.

**Message display** The message display shows the operating mode, rate, status, and current events. For example, the message display might display a confirmation message informing you that a TestPad on the far end of a circuit is in loopback mode. To view historical messages, select the

up arrow in the message display. The Message History Pane appears, listing up to ten historical messages. To close the pane and return to the main screen, select the down arrow.

## System buttons

Two system buttons are located to the right of the message display.

### *Tools button*

The Tools button displays the Tools menu which provides access to the commands in Table 5.

**Table 5** Tools menu commands

| Command ... | Used to ... |
|---|---|
| Programs | Access a variety of applications, such as the On-screen Keyboard, PDF Viewer, and VNC Viewer. If you purchase the Web browser or VT-100 emulation options, the associated applications are also listed as menu commands. |
| TestPad Settings | Specify screen saver, brightness, speaker, and date and time settings. |
| Connectivity | Specify parameters for printer, network, Serial Remote Command Line, and Remote GUI connections. |
| File Management | Access the File Management dialog box to manage files and transfer files to and from the TestPad using FTP. |
| FST-2310 Settings | Access the FST-2310 revision information and load upgrades and options. You can also reset the FST-2310 by clearing NOVRAM and returning the unit to factory default settings. |
| Print Management | Set up and schedule print events, create headings for print output, and print test configurations, test results, and histograms. |
| Store/Recall Setups | Access the Saved Setups dialog box. Using the options on the screen, you can store test configurations. After you store a configuration, you can recall and load the configuration to automatically configure a test. |

**Table 5** Tools menu commands (Continued)

| Command ... | Used to ... |
|---|---|
| AutoMATE | If you purchase the scripting option, access the automated test scripts you develop using Tcl/Tk. If you purchase the scripting library, access the automated test scripts developed by Acterna. |
| Help | Launch FST-2310 Help. |
| Test Restart | Restart your test. |

***Power Status button***

The Power Status button displays current battery strength by bar graph and percentage and indicates whether the TestPad is powered using an AC power adapter.

## Extended Keypad

The Extended Keypad is located to the right of the touch-sensitive screen. The keys are used to initiate specific operations on the TestPad (such as a test restart or screen toggle), launch the on-screen keyboard or online help, or access dialog boxes to control the brightness of the screen and to set up print events. Table 6 describes the function of each key.

**Table 6** Extended Keypad keys

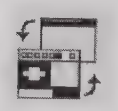
| Icon | Description |
|---|---|
| | Restart—Press this key to restart a test. When you restart a test, the TestPad resets the current test result totals and clears any errors and/or alarms. |
|  | Toggle Screen—Press this key to toggle between applications. For example, if you launched the Web browser, press this key to toggle between the TestPad user interface and the browser. |
| | Brightness—Press this key to access the Screen Brightness tab. |

**Table 6** Extended Keypad keys (Continued)

| Icon | Description |
|---|---|
| | Keyboard—Press this key to launch the on-screen keyboard. |
| | Printer Setup—Displays a series of tabs which allow you to schedule or generate print output on the TestPad. |
| | Help—Launches FST-2310 Help. |

**NOTE:**

When you use the Remote GUI, you can use the Tools menu to access each of the commands associated with the Extended Keypad keys.

# Basic Operations

2

This chapter provides step-by-step instructions for each of the basic operations you can perform using the FST-2310. Topics discussed in this chapter include the following:


- "Connecting and swapping application modules" on page 22
- "Maintaining the battery" on page 24
- "Connecting a USB device" on page 26
- "Setting up the FST-2310" on page 28
- "Selecting Custom results" on page 38
- "Restoring factory defaults" on page 39
- "Printing test configurations, test results, and histograms" on page 40
- "Using the on-screen keyboard" on page 54
- "Sending e-mail" on page 55
- "Launching Adobe Acrobat Reader" on page 59
- "Launching the VNC Viewer" on page 59
- "Launching the Web browser" on page 61
- "Emulating a VT100 terminal" on page 61
- "Using the Remote GUI" on page 62
- "Managing files" on page 64

## Connecting and swapping application modules

Connecting an application module simply involves aligning the guide rails of the UIM and the application module in a parallel position, and then sliding the application module into the UIM. Swapping application modules involves turning the TestPad off, disconnecting the attached application module from the UIM (again, keeping the guide rails for both modules parallel), and then attaching the new application module to the UIM.

**NOTE:**

FST-2310 application modules running software version 9.0 and higher require a Version 6 or higher UIM. If you connect a FST-2310 application module running software version 9.0 or higher to an older UIM, a message will appear on the user interface instructing you to remove the application module and attach it to a newer UIM.

**To connect or swap application modules**

1. If an application module is connected to the UIM and the TestPad is on, turn off the TestPad.
2. If you are swapping application modules, turn the screw on the front of the application module counter-clockwise to release the application module.
3. If you are swapping application modules, disconnect the current application module from the UIM by gently pulling the two modules apart, keeping the guide rails for the two modules parallel at all times.
4. On the back of the application module you are about to connect, verify that the label says "FST-2000 INTEROPERABLE" (indicating that the application module is compatible with a Version 6 or higher UIM).
5. Align the guide rails of the application module and the UIM in a parallel position (see Figure 7).

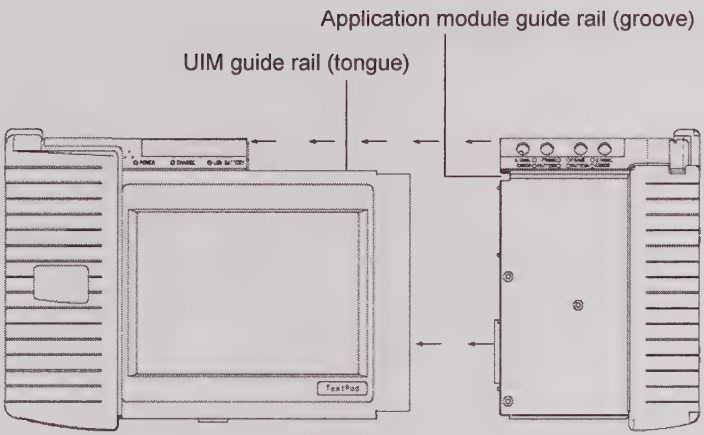



**Figure 7** UIM and application module alignment

6 Slide the application module into the UIM, keeping the two modules parallel at all times (see Figure 8).

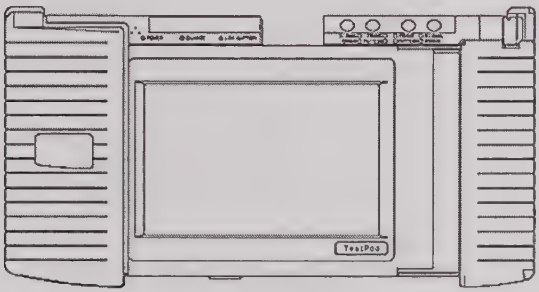


**Figure 8** UIM and application module connection

7 Turn the screw clockwise to secure the TestPad.

The TestPad is ready for use.

**NOTE:**

When you turn the TestPad on for the first time, the UIM and the application module will take several minutes to initialize the software. Do not turn the power off during initialization or you may corrupt the files.

## Maintaining the battery

The TestPad comes equipped with a rechargeable Nickel-Metal Hydride (NiMH) battery. The battery life of a fully-charged battery varies depending on the type of functions that you are performing.

If the battery is not charged with sufficient capacity to power the TestPad, the TestPad will not completely power up, and the `LOW BATTERY LED` will illuminate. You can power the TestPad and recharge the battery using the supplied AC adapter.

To prolong the life span of the battery, follow the guidelines below:

- Store the battery in a cool, dry, and clean environment. Do not leave the battery in a car or truck, particularly during extremely warm weather.
- Use the AC adapter to power up the TestPad the first time you use the TestPad, or after prolonged storage.
- Before using the battery to power the TestPad, check the battery capacity.
- If the battery capacity is depleted or if the battery has been stored for a prolonged period, use the Acterna battery charger to charge the battery. Do not use an un-approved charger.
- Condition the battery after prolonged storage or 30 cycles of use. To condition the battery, deeply discharge the battery, and then recharge the battery fully three times.
- If the TestPad will not be used for more than a week, remove the battery.
- Do not charge the battery after exposure to extremely hot or cold temperatures.
- If the battery capacity is depleted and you are not ready to recharge the battery, turn the TestPad power OFF.
- Always carry a fully charged spare battery.

### Viewing the battery charge status

**To view the battery charge status**

- Look at the Power Status button on the user interface. The button displays the current battery strength using a bar graph and percentage.

## Charging the battery

The LOW BATTERY LED illuminates when the battery is below 25 percent capacity. You can recharge the battery using an AC adapter.

**NOTE:**

Environmental conditions such as the temperature of the battery may cause the charging process to terminate before the battery is completely recharged. The internal battery charger can operate when the TestPad is on; however, to ensure a complete recharge, turn the TestPad off, remove the AC adapter, and then verify that the battery is cool to the touch before beginning a new charge cycle.

**To charge the battery**

1. Turn off the TestPad.
2. Verify that the battery is cool to the touch. If the battery is warm, wait for it to cool down before proceeding to step 3.
3. To start a new charge cycle, or to restart a charge cycle that was terminated, do one of the following:
   - If the battery is already in the TestPad, insert or reinsert the AC adapter.
   - If the AC adapter is already plugged in, insert or reinsert the battery into the TestPad.
4. Let the battery charge for up to two hours depending on the current charge state of the battery.

The battery is charged.

## Replacing the battery

The following procedure describes how to replace the battery in a TestPad.

**CAUTION: DANGER OF EXPLOSION**

Risk of explosion if battery is replaced with an incorrect type.

Replace with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

**NOTE:**

The battery can be "hot swapped" which means if AC power is connected, you can replace the battery without affecting the current test.

**To replace the battery**

1 Turn off the TestPad or connect AC power.

2 Unlock the battery access panel by turning the screw counterclockwise. See Figure 3 on page 13.

3 Open the battery access panel.

4 Pull the strap to remove the battery.

5 Align the new battery with the terminals facing up and pointing toward the battery compartment.

6 Verify that you can read the terminal markings (-) V D C (+) at the top end of the battery.

7 Slide the new battery into the battery compartment until the terminals click into place.

The bottom of the battery should be about 0.25 inches (0.635 centimeters) inside the compartment.

8 Close the battery access door, and then lock the door by turning the screw clockwise.

9 If the TestPad is on, you can resume testing. If you turned the TestPad off, turn it on to resume testing.

The battery is replaced.

## Connecting a USB device

You can connect a USB keyboard, mouse, or printer to the TestPad. If you want to use more than one USB device simultaneously, you can connect a USB hub to the TestPad, and then connect each device to one of the four ports available on the hub.

**To connect a USB device to the TestPad**

1 Insert a Y cable into the USB/Serial port. This cable provides a USB connector.

**NOTE:**

You must connect the Y cable to the USB/Serial port before you connect the keyboard, mouse, printer, or hub cable to the USB connector.

2 Do one of the following:

| To ... | Do this ... |
|---|---|
| Connect a keyboard or mouse | Insert the keyboard or mouse cable into the USB connector of the Y cable. |
| Connect a printer | Attach one end of the printer cable (supplied with the printer) to the printer, and then attach the other end to the USB connector of the Y cable. |
| Connect a USB hub | Attach the hub cable to the USB connector of the Y cable, and then connect the USB devices to the hub. |

The USB device is connected.

**NOTE:**

The TestPad also provides an on-screen keyboard which allows you to type by tapping keys on a keyboard displayed on the touch-sensitive screen. For instructions on using the on-screen keyboard, see "Using the on-screen keyboard" on page 54.

# Setting up the FST-2310

Setting up the FST-2310 involves specifying a password for the Remote GUI, and specifying various settings for the TestPad such as the date and time format, screen saver, screen brightness, and speaker volume. It may also involve loading software upgrades and options.

## Specifying a Remote GUI password

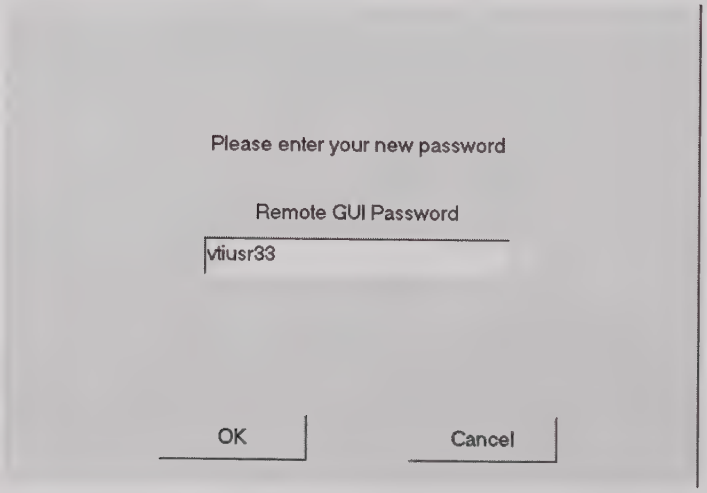
If you intend to use the Remote GUI to control the TestPad from a remote PC or laptop, you must specify a Remote GUI password to secure access to the TestPad. Each time you initiate a Remote GUI session, you'll be required to enter the password.

The default Remote GUI password is `acterna`.

**To specify a Remote GUI password**

1 Select **Tools > Connectivity**.
The Connectivity Menu appears.

2 Select **Remote GUI**.
The Remote GUI Password dialog box appears.



3 In **Remote GUI Password**, type a password using up to eight characters, and then select **OK**.

The Connectivity Menu appears, and the Remote GUI password is set.

## Specifying date and time settings

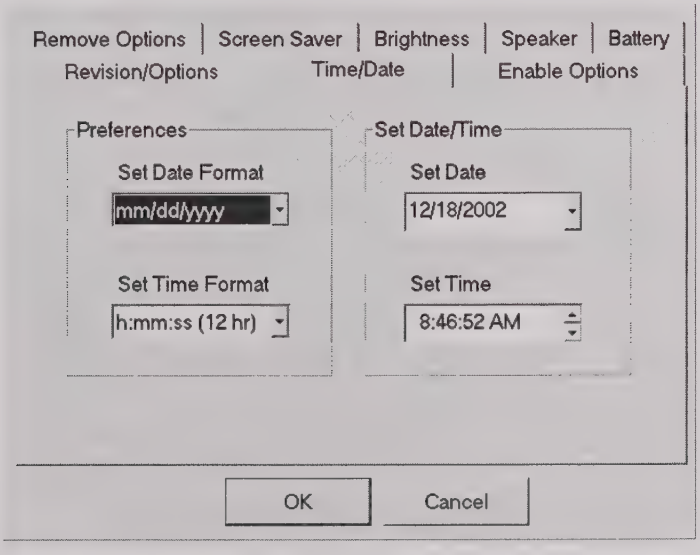
By default, the TestPad presents dates on print files using a standard MM/DD/YYYY format, and time using a standard Hour:Minute:Second format. You can change the date, time, or format at any time.

**To specify date and time settings**

1 Select **Tools** > **TestPad Settings**.

A series of setup tabs appears.

2 Select **Time/Date**.




3 To specify the settings, do the following:

| To ... | Do this ... |
|---|---|
| Set the date format | In **Set Date Format**, select a date format. |
| Set the time format | In **Set Time Format**, select a time format. |

| To ... | Do this ... |
|---|---|
| Set the date | Select the arrow to the right of the Set Date field. A calendar appears. Do one of the following:<br>– To select a date from the month and year displayed, simply select the date.<br>– To navigate through the calendar to select a date from a different month or year, use the arrows at the top of the calendar to display the month, and then select the date. |
| Set the time | In Set Time, select the hour, minutes, or seconds you want to modify, and then select the up or down arrow to the right of the field to increase or decrease the value in increments of one. |

4 Select **OK**.

The date and time settings are specified.

## Setting up the screen saver

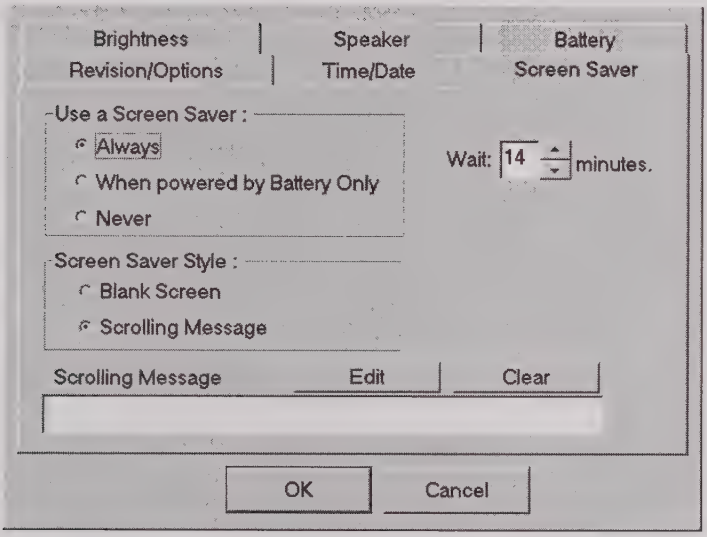
The TestPad is equipped with a screen saver. You can setup the TestPad to use the screen saver, or you can disable the screen saver entirely. If you use the screen saver, you can specify how much time must elapse before the TestPad displays the screen saver, and you can optionally display a blank screen or a scrolling message whenever the screen saver appears.

### To set up the screen saver

1 Select **Tools** > **TestPad Settings**.

A series of setup tabs appears.

2 Select **Screen Saver**.




3 If you do not want to use a screen saver, under User a Screen Saver, select **Never**, and then proceed to step 4.

If you do want to use a screen saver, do the following:

**a** Select an option for Use a Screen Saver.

**b** Select a screen saver style: Blank Screen or Scrolling Message.

**c** If you selected Scrolling Message, select **Edit** to display the Enter new message dialog box, and then type the message.

Select **OK** to return to the Screen Saver tab.

**d** Select the time to elapse before the screen saver appears.

4 Select **OK**.

The screen saver is set up.

## Setting the screen brightness

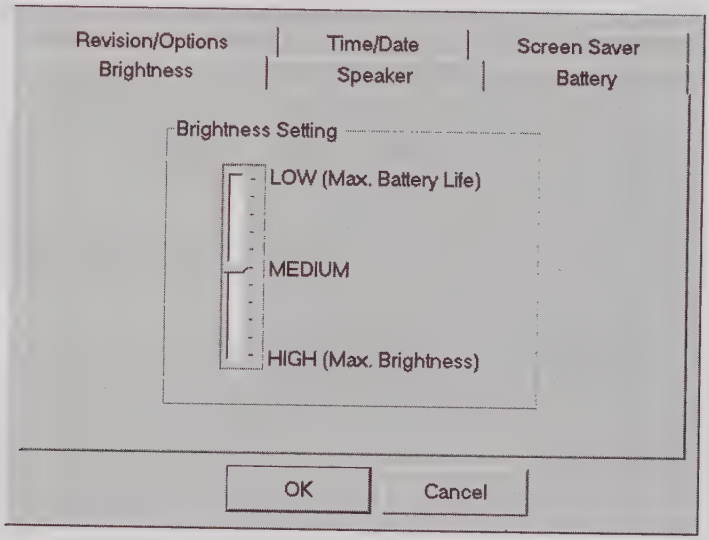
You can control the screen brightness on the TestPad. Higher brightness provides greater clarity when viewing the user interface.

**To set the screen brightness**

1 Select **Tools** > **TestPad Settings**.

A series of setup tabs appears.

2 Select **Brightness**.




3 Under Brightness Setting, drag the pointer to the level of brightness you want to use for the screen.

4 Select **OK**.

The screen brightness is set.

## Specifying speaker settings

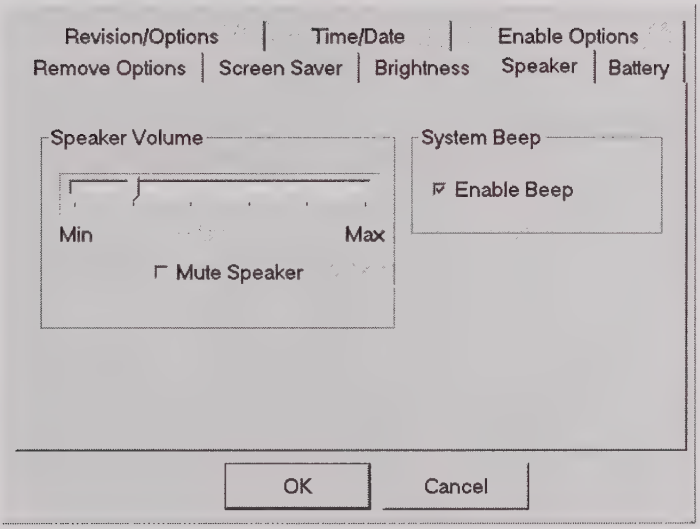
You can control the speaker volume on the TestPad or mute the speaker entirely. You can also setup the TestPad to beep whenever you insert or remove a PCMCIA card or whenever you select a button on the user interface.

### To specify speaker settings

1 Select **Tools** > **TestPad Settings**.

A series of setup tabs appears.

2 Select **Speaker**.




3 To control the speaker's volume, do one of the following:
   - If you want to adjust the speaker volume, under Speaker Volume, drag the pointer to the level of volume you want the speaker to use.
   - If you want to mute the speaker volume entirely, select **Mute Speaker**.

4 To set up the TestPad to beep whenever you insert or remove a PCMCIA card or select a button on the user interface, select **Enable Beep**.

5 Select **OK**.

The speaker settings are specified.

## Loading options and software upgrades

If you purchase options or obtain an FST-2310 or UIM software upgrade, you receive a PCMCIA card with the software for the options or upgrade. Loading options or FST-2310 software upgrades involves inserting the PCMCIA card into a PCMCIA card slot, loading the software, and then waiting for the TestPad to reboot. Loading options is typically a quick process; loading an FST-2310 software upgrade takes longer.

For instructions on loading UIM software upgrades, refer to the upgrade instructions provided with the upgrade card.

### *Loading options*

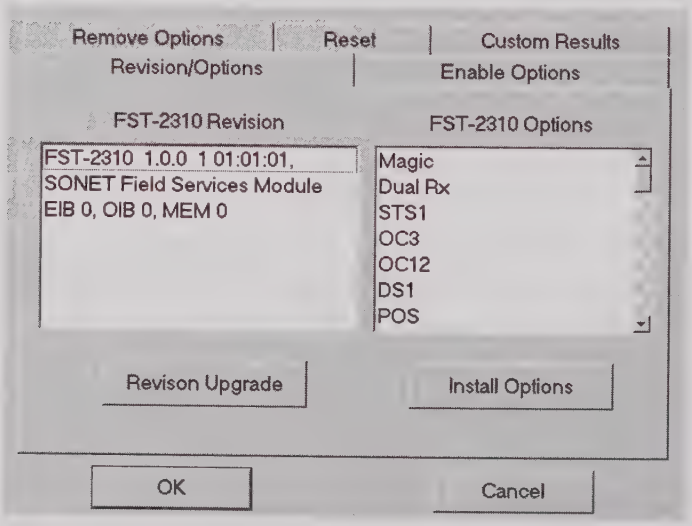
You can load options from a single PCMCIA card or from two separate PCMCIA cards simultaneously.

**To load options**

1 Insert the PCMCIA card or cards with the options in a PCMCIA card slot.

2 Select the **Tools** button, and then do one of the following:

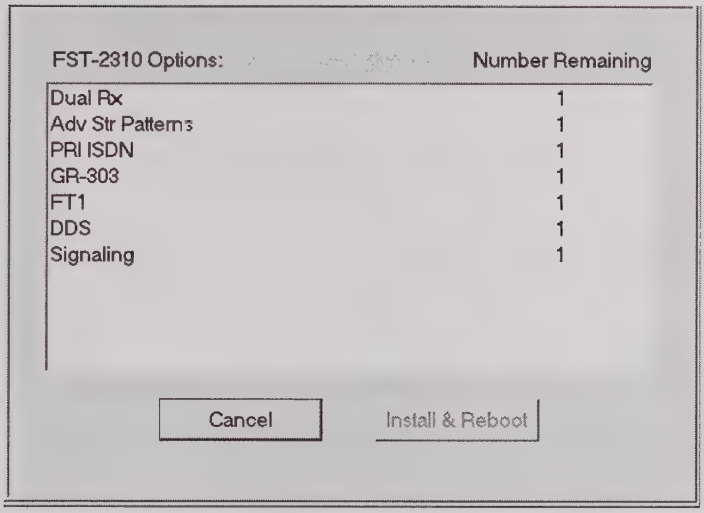
- To load UIM options, select **TestPad Settings**, and then select the **Revisions/Options** tab.
- To load FST-2310 settings, select **FST-2310 Settings**. The Revisions/Options tab appears.




Currently installed options on the TestPad appear under TestPad Options or FST-2310 Options.

3 Select **Install Options**.

The Options Installation dialog box appears, listing the options available on the PCMCIA card (or cards).




**NOTE:**

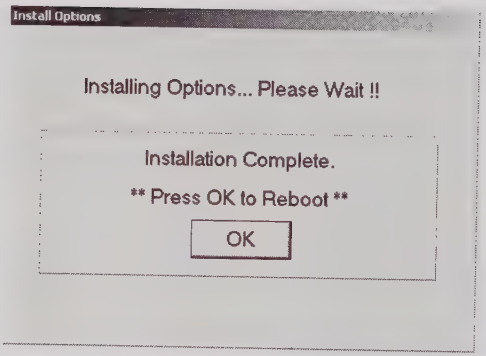
If you inserted two PCMCIA optioning cards into the TestPad, and both cards include the same option, the option appears twice in the list of options.

The Number Remaining field indicates the remaining copies of the option which are available for installation. Each time you install an option, the TestPad decreases the number remaining by one.

4 Select the option or options you want to install.

5 Select **Install & Reboot**.

The TestPad installs the options, and then the Install Options dialog box appears.




**6** Select **OK** to acknowledge the message.

The TestPad reboots and the options are available.

### *Loading an FST-2310 software upgrade*

Before you load an FST-2310 software upgrade, you must power the TestPad using an AC adapter. We also recommend using a battery charged to at least 50 percent capacity as a backup power supply.

If you insert a PCMCIA card into the TestPad with an FST-2310 software upgrade before you turn the TestPad on, the TestPad automatically detects a new version of the software when it boots up and asks if you want to upgrade the software.

Loading an FST-2310 software upgrade typically takes about twenty-five minutes.

**CAUTION: DAMAGE TO TESTPAD**

When you load an FST-2310 software upgrade, the TestPad deletes all existing application module software, automatically reboots, and then loads the software upgrade. Therefore, if power is interrupted during the course of the upgrade, the TestPad may require factory service to operate.

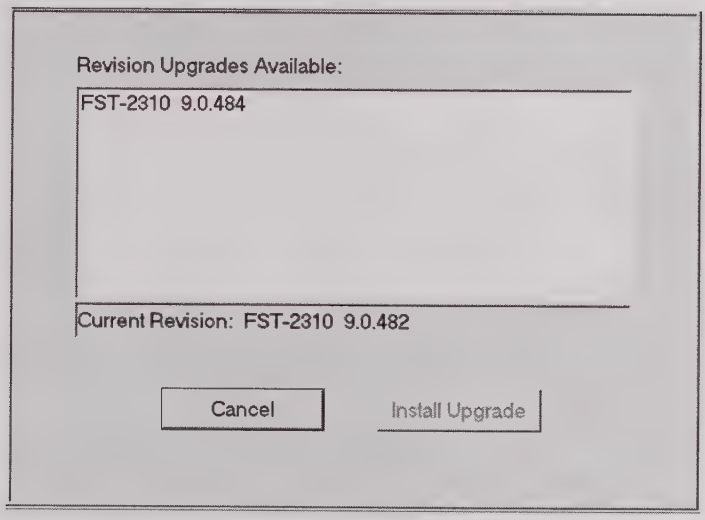
**To load a software upgrade**

1. Insert the PCMCIA card with the software upgrade in a PCMCIA card slot.
2. Turn the TestPad power ON.

A dialog box appears informing you that a newer version of software has been detected for the application module, and asking if you want to upgrade the software.

3 Select **Yes**.

The Revision Upgrades Available dialog box appears.

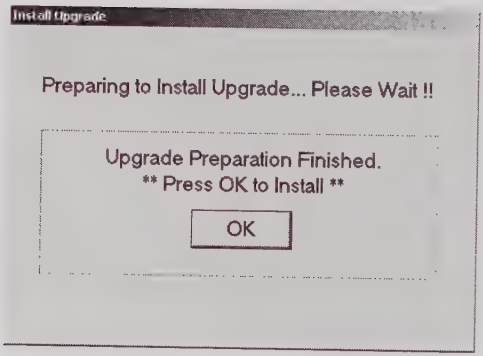



**NOTE:**

If you insert a PCMCIA card with a software upgrade after you turn the TestPad on, you can select **Tools > FST-2310 Settings** to display the Revision Upgrades Available dialog box and update the FST-2310 software.

4 Select the software upgrade you want to load, and then select **Install Upgrade**.

The Install Upgrade dialog box appears.




5 Select **OK** to install the upgrade.

6 The TestPad displays the following warning:

```
WARNING

DO NOT TURN POWER OFF AT THIS TIME.

Transfer of system files in progress. System may
require factory service if power fails during
transfer.
```

The TestPad loads the software update and then reboots.

## Selecting Custom results

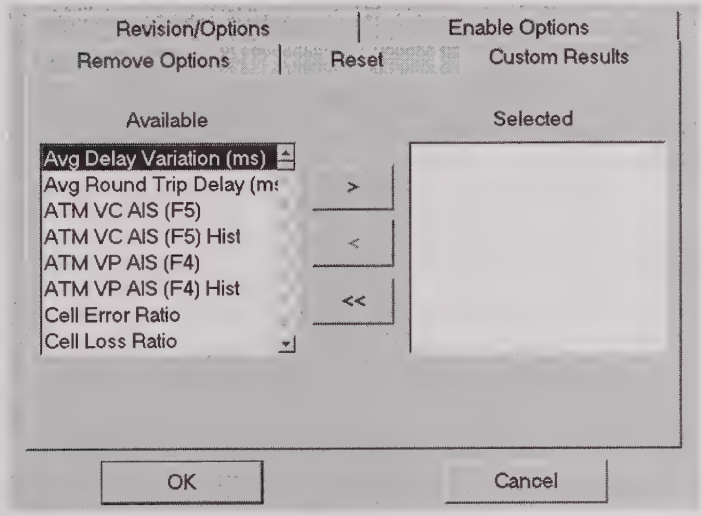
You can display results from a variety of categories on a single result pane by selecting results for the Custom result category.

**To select Custom results**

1 Select **Tools** > **FST-2310 Settings**.

The Reset tab appears.

2 Select the Custom Results tab.




3 Select the results from the Available list, and then do one of the following:

   – Use the **>** and **<** arrows to move single results between the Available and Selected list boxes.

   – Use the **<<** arrows to move all selected results back to the Available list box.

4 Select **OK** to return to the main screen.

Results are selected for the Custom result category.

## Restoring factory defaults

You can restore the FST-2310 settings to the factory defaults using the Clear NOVRAM feature. When you clear NOVRAM, the TestPad restores the following settings:

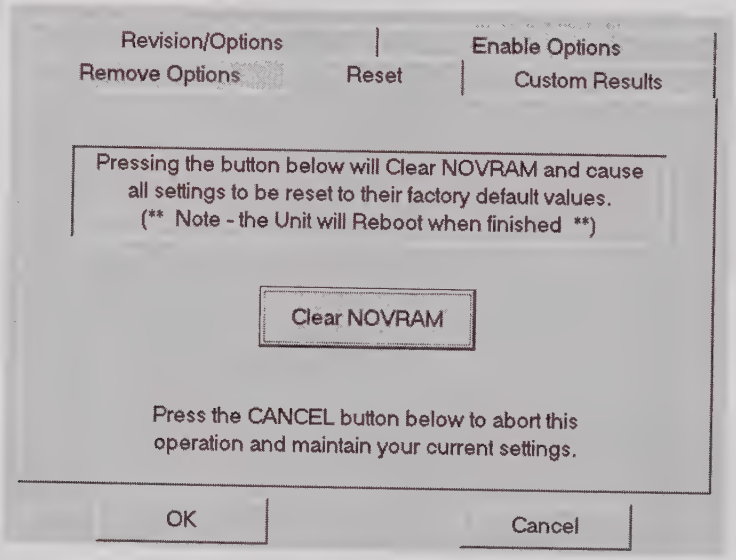
– Test applications. All test applications for the FST-2310 are restored to their default values.

– Print Management settings. The print management settings are restored to their default values.

**To restore factory defaults**

1 Select **Tools** > **FST-2310 Settings**.

The Reset tab appears.


Revision/Options
Enable Options
Remove Options
Reset
Custom Results
Pressing the button below will Clear NOVRAM and cause all settings to be reset to their factory default values.
(** Note - the Unit will Reboot when finished **)
Clear NOVRAM
Press the CANCEL button below to abort this operation and maintain your current settings.
OK
Cancel

2 Select **Clear NOVRAM**.

The TestPad restores the FST-2310 settings back to the factory defaults. This typically takes about ten seconds, and then a message appears informing you that the settings are restored.

3 Select **OK** to acknowledge the message.

The TestPad reboots, and the settings are restored.

## Printing test configurations, test results, and histograms

You can print test configurations, test results, and histograms from the TestPad. Printing involves connecting a printer, and then specifying print parameters such as the print mode, print type, and print event triggers. If you connected a serial printer, you must also configure the printer.

After you specify the print parameters, you are ready to generate print output. When you generate print output, you can send the output directly to a printer, or you can store the output in a file on the TestPad to print at a later time. You can also automatically e-mail print output when you generate the output. For example, if you want your Technical Support department to review your test results, you can set up the TestPad to automatically e-mail the results to the department.

The following sections introduce you to some basic concepts about printing, and then describe how to connect a printer, configure a serial printer, specify print parameters, and print your print files.

## Default.txt file

The first time you generate print output, by default, the TestPad appends the output to the default print file, `default.txt` in the following directory:

`Acterna\Files\FST-2310`

When you specify print parameters for the output, you can do the following:

- You can clear the output in the `default.txt` file, and then repopulate the file with new output.
- You can direct the print output to a new or different `.txt` file.

## Print modes

Print modes identify the way you want to generate print output: manually, at timed intervals, or when a test ends. You specify the print mode for your print output in the Print Mode field of the Setup tab.

## Print types

Print types represent the type of information you want to include in the print output. When you specify print parameters, you specify the print type for your print output in the Print Type field of the Setup tab.

**NOTE:**

To print test configurations (controls) and histograms, you must generate print output in manual mode.

## Print event triggers

Print event triggers cause the TestPad to generate print output whenever the event (a result change, test restart, or a remote user connects or disconnects to the TestPad) occurs. The event output includes a date and time stamp indicating when the event occurred.

## Connecting a printer

The USB/Serial port, located on the top panel, is used to connect the standard Y cable provided with the TestPad. The Y cable provides a USB connector and a serial connector, allowing you to connect a USB printer, such as the 2000-USB-PRINTER, or serial printer, such as the PR-40B to the TestPad.

**To connect the printer**

1. Turn on the TestPad.
2. Attach the Y cable to the USB/Serial port.
3. Do one of the following:
   - If you are connecting a serial printer, using the supplied printer cable, connect the DB-9 female connector on the printer cable to the serial connector on the Y cable, and then connect the DB-9 male connector on the printer cable to the printer.
   - If you are connecting a USB printer, using the supplied printer cable, connect the cable to the USB connector of the Y cable, and then connect the other end of the printer cable to the printer.

**NOTE:**

When connecting to the PR-40B serial printer, use the printer cable provided with the printer. Operability of the printer port cannot be guaranteed if you use a cable longer than 3 meters.

By default, the baud rate for the serial printer interface is 9600, and the parity method is none. If you need to change these settings, see "Configuring a serial printer" on page 42.

## Configuring a serial printer

Configuring a serial printer involves specifying the printer device, and then specifying the communications parameters, such as the baud rate, data bits, parity, stop bits, and flow control.

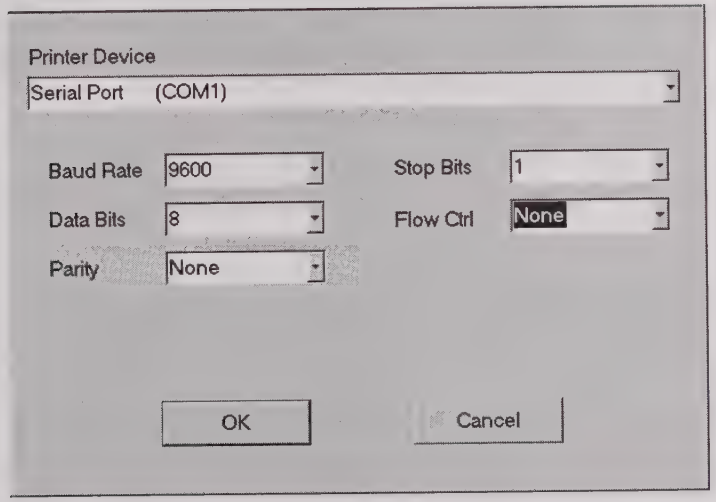
**To configure a printer**

1 Select **Tools** > **Connectivity**.

The Connectivity Menu appears.

2 Select **Serial Printer**.

The Printer Configuration dialog box appears.




3 If you have either a serial card or a Y cable connected to the TestPad, the serial printer device available appears automatically under **Serial Printer Device**.

If you have both a serial card and a Y cable connected to the TestPad, under Serial Printer Device, select **Serial Card** to connect via a card, or **Serial Port** to connect via the serial port on the Y cable.

4 Specify the settings for the printer, and then select **OK**. Default values for each of the settings are as follows:

- Baud rate: 9600
- Data bits: eight
- Parity: None
- Stop bits: None
- Flow control: None

The printer is configured.

**NOTE:**

You can also use the Configure option on the Setup tab to configure a printer when you specify print parameters.

## Creating a heading for print output

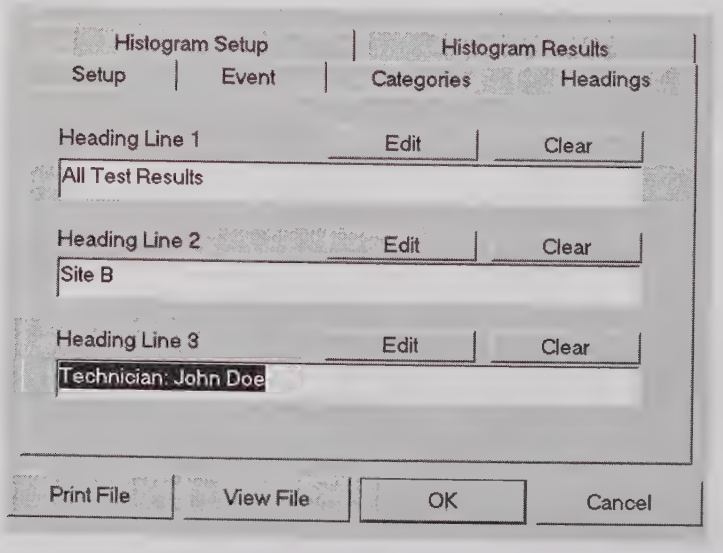
You can create a custom heading for print output. These headings are particularly helpful if you append print output to the same print file each time you print. By defining unique headings for your print output, you can easily identify the output associated with each test.

**To create a heading**

1 Select **Tools** > **Print Management**.

A series of print management tabs appear.

2 Select **Headings**.




3 In **Heading Line 1**, type the first heading you want to appear on the print file.

4 If you want a second and third heading, type the headings in the corresponding fields.

5 Select **Setup** to return to the Setup tab, or **OK** to return to the main screen.

The heading is created and will appear above your print output.

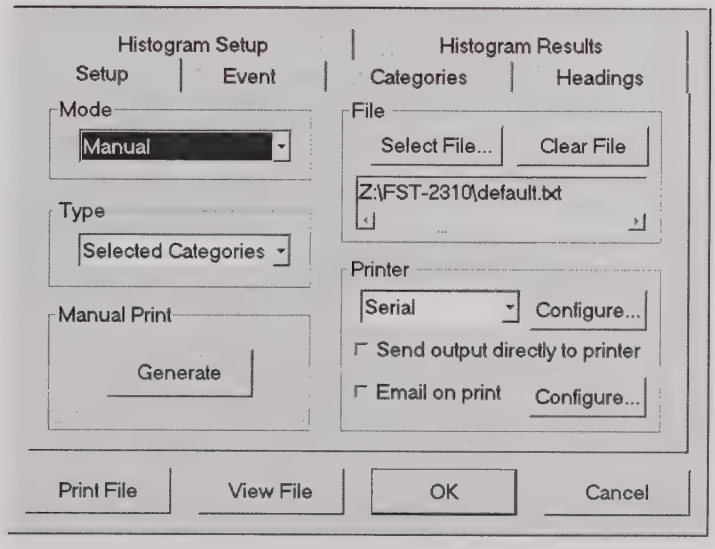
## Generating print output

Generating print output involves specifying the print mode, specifying a print type (and defining print type parameters, if necessary), and then selecting the Generate button to generate the print output immediately, or scheduling the TestPad to automatically generate print output.

### To generate print output

1 Select **Tools** > **Print Management**.

The Setup tab appears.




2 In Mode, select one of the following print modes:

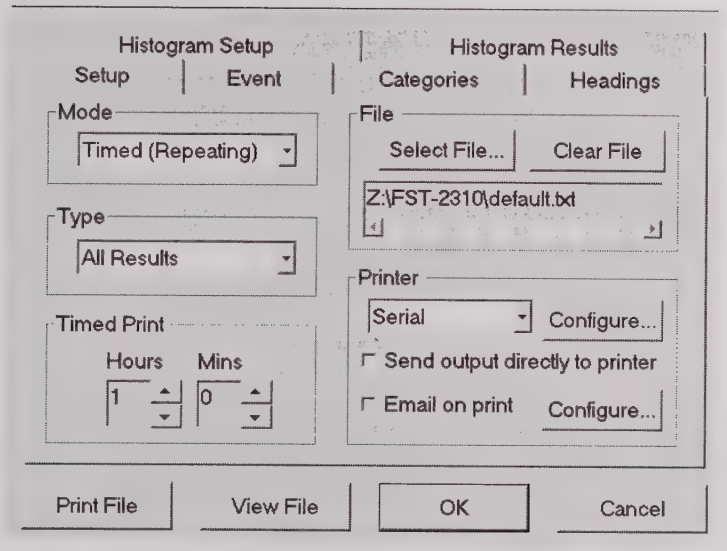
| Select | To ... |
|---|---|
| Manual | Manually generate print output. Proceed to step 4. |

| Select | To ... |
|---|---|
| Timed (Repeating) | Generate print output at regularly scheduled intervals.<br>For example, if you want the TestPad to generate test results output every ten minutes, select the Timed (Repeating) print mode, and then proceed to step 3 to specify the interval between generated print output. |
| Timed (Test End) | Generate print output whenever a test ends.<br>For example, if you want the TestPad to generate test results output when a test ends in thirty minutes, select the Timed (Test End) print mode, and then proceed to step 3 to specify the amount of time after a test restart (thirty minutes) that will pass before the test ends. |

**NOTE:**

You must select Manual mode to print test configurations (controls) and histograms.

If you selected **Timed (Repeating)** or **Timed (Test End)**, fields appear on the Setup tab which allow you to specify the interval between TestPad generated print output or the amount of time that will pass after a test restart before a test ends.

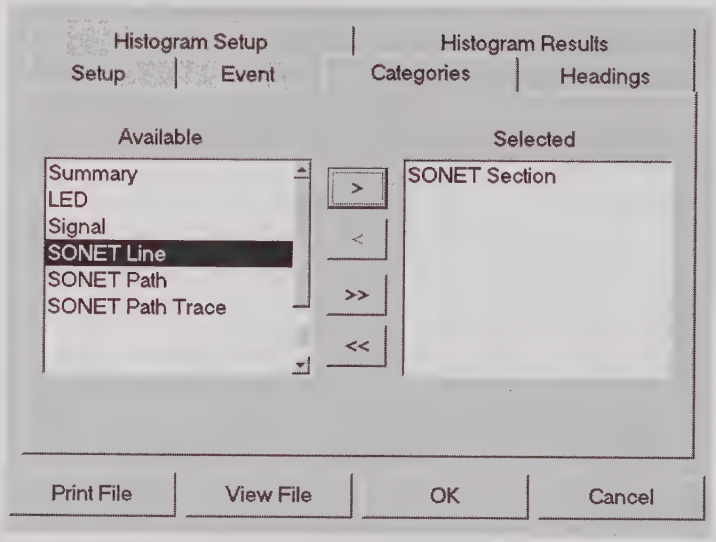



3 In **Hours** and **Mins**, type the hours or minutes, or select the up and down arrows next to the fields to increase or decrease the displayed value.

4 In **Type**, select one of the following print types:

| Select ... | To ... |
|---|---|
| All Results | Print all test results for a test. Proceed to step 7. |
| Selected Categories | Print test results for a specific group of categories. Proceed to step 5. |
| Controls | Print the configuration for a test. Proceed to step 7. |
| Histogram | Print specific results based upon the histogram configuration. Proceed to step 6. |

5 If you chose Selected Categories as the print type in step 4, select the **Categories** tab to choose the categories for the print output, and then do the following:




**a** To select categories, use the **>** and **<** arrows to move single categories between the Available and Selected list boxes, or use the **>>** and **<<** arrows to move all categories.

**b** Proceed to step 7.

**6** If you selected Histogram as the print type in step 4, see "Setting up a histogram" on page 50 for instructions on setting up histogram output, and then proceed to step 7.

**7** *Optional.* If you want the TestPad to generate print output whenever you restart a test, a result changes, or a remote user connects or disconnects to the TestPad, select the **Event** tab, and then select **Test Restart**, **Result Change**, or **Remote User Connect/Disconnect**.

**8** Return to the Setup tab.

**9** *Optional.* If you want to clear the displayed print file, or direct the print output to a new or different file, do one of the following:

| To ... | Do this ... |
|---|---|
| Clear the displayed print file, and then re-populate the file with new output | Select **Clear File**. |
| Direct the print output to a new file | Choose **Select File** to display the File Management dialog box, and then do the following:<br>– Select the **File Name** field. An Acterna keypad appears.<br>– Type the new file name.<br>– Select **OK** to return to the Setup tab. |
| Direct the print output to a different file | Choose **Select File** to display the File Management dialog box, and then do the following:<br>– Under File Name, select the file you want to direct the output to.<br>– Select **OK** to return to the Setup tab. |

**10** *Optional.* If you want to send the output directly to a printer, select **Send output directly to a printer**, and then select the printer you want to direct the output to (**Serial** or **USB**).

**11** *Optional.* If you want to email the output when it is generated, select **Email on print**. See "Sending e-mail" on page 55 for instructions on sending e-mail from the TestPad.

**12** Select **Generate** or **Print File**.

**13** If you want to store the print settings you specified, select **OK** to return to the Main Screen. If you do not want to store the print settings, select **Cancel**.

If you sent the print output directly to a printer, the TestPad prints the output and sends the output to the `.txt` file you specified. If you sent the print output to a file, the output is stored in the `.txt` file to be printed at a later time.

## Setting up a histogram

A histogram is print output of test results in a bar graph format. Histograms enable you to quickly identify spikes and patterns of errors over a specific interval of time. Figure 9 shows a sample Histogram printout.

```
Create Print File Event
Test Name: Terminate VT1.5 T1 BERT in STS-1
11/19/2002  10:45:04 PM

*********************************************************
Histogram Print
Test Name: Terminate VT1.5 T1 BERT in STS-1
11/19/2002  10:45:06 PM

Result: Bit Errors  RX: Primary
Duration: 0,00:07
                        0    10   20   30   40   50   60   70   80   90   100
                        +----+----+----+----+----+----+----+----+----+----+-+
11/19/2002 10:38:54 PM +*****                                                10
11/19/2002 10:39:57 PM +****                                                 9
11/19/2002 10:40:54 PM +****                                                 9
11/19/2002 10:41:54 PM +****                                                 9
11/19/2002 10:42:54 PM +*****                                               10
11/19/2002 10:43:54 PM +****                                                 9
11/19/2002 10:44:54 PM +********************                                40
11/19/2002 10:45:54 PM +****                                                 9
```

**Figure 9** Histogram printout

Each time you run a test, the TestPad automatically accumulates data for a histogram in the histogram buffer. Whenever you start a new test, the histogram buffer clears, and then populates with data from the new test.

You can choose which results to collect for the histogram print output, and when the TestPad will collect the samples.

### To set up histogram print output

1 Select the **Tools** button.

  The Tools Menu appears.

2 Select **Print Management**.

  The Setup tab appears.

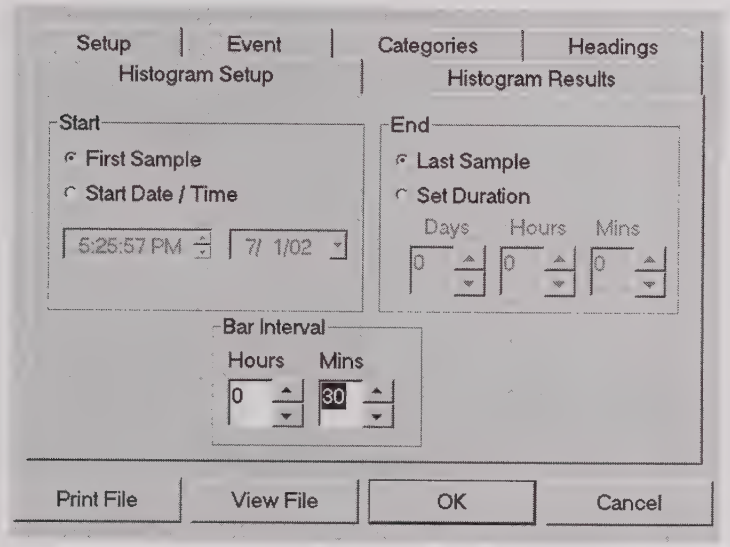
3 In Mode, select **Manual**.

**NOTE:**

You cannot print histograms in Timed (Repeating) or Timed (Test End) modes.

4 In Type, select **Histogram**.

5 Select the **Histogram Setup** tab.




6 Under Start, do one of the following:

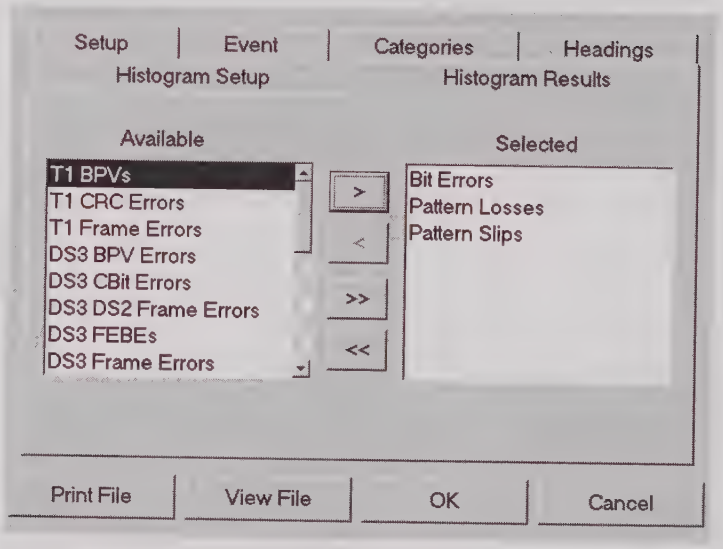
- Select **First Sample** to select all available data for the print output from the moment the test starts.
- Select **Start Date/Time** to specify the start data and time for data collection for the histogram. If you select this option, you must type the date and time the TestPad will start collecting data in the associated fields.

7 Under End, do one of the following:

- Select **Last Sample** to select all available data for the print output from the moment you select **Generate** to generate output for the histogram.
- Select **Set Duration** to specify a duration of time during which the TestPad will collect data for the histogram. If you select this option, you must type the days, hours, and minutes for the duration in the associated fields.

8 Under Bar Interval, type the hours and minutes represented in each histogram bar.

**9** Select the **Histogram Results** tab.




**10** To select the result categories for the histogram, do one of the following:

**a** Select the categories you would like to include in the print output. Use the **>** and **<** arrows to move single categories between the Available and Selected list boxes. Use the **>>** and **<<** arrows to move all categories.

**b** Select **OK**.

**NOTE:**

The result categories available for a histogram depend on the current test configuration. Each time you configure a test using the same settings, the histogram categories you selected previously for the configuration are automatically available; however, you can edit the categories at any time.

**11** In Printer, select the printer you want to direct the histogram output to (**Serial** or **USB**).

**12** *Optional.* If you want to send the histogram directly to a printer, select **Send output directly to a printer**.

13 *Optional.* If you want to email the histogram when it is generated, select **Email on print**. See "Sending e-mail" on page 55 for instructions on sending e-mail from the TestPad.

14 Select **Generate** or **Print File**.

If you sent the histogram directly to a printer, the TestPad prints the histogram and sends the output to the `.txt` file you specified. If you sent the histogram to a file, the output is stored in the `.txt` file to be printed at a later time.

## Viewing stored print files

You can view stored print files using the View File button on the Setup tab.

**NOTE:**

You can also view stored print files from the File Management dialog box. See "Viewing, running, deleting, or renaming a file" on page 67.

### To view a stored print file

1 Select **Tools > Print Management**.

The Setup tab appears.

2 Under File, the most recently created print file appears. Do one of the following:

- To view the displayed print file, proceed to step 3.
- To view a different print file, choose **Select File**, and then select the print file you want to view.

3 Select **View File**.

The print file appears in the Print Viewer dialog box.

## Printing a stored print file

You can print stored print files using the Print File button on the Setup tab.

### To print a stored print file

1 Select **Tools** > **Print Management**.

The Setup tab appears.

2 Under File, the most recently created print file appears. Do one of the following:
   - To print the displayed print file, proceed to step 3.
   - To print a different print file, choose **Select File**, and then select the print file you want to print.

3 Select **Print File**.

The print file is printed.

## Using the on-screen keyboard

The FST-2310 provides an on-screen keyboard, which you can use to type information in the active window when you use the Web browser, use the VNC Viewer, or emulate a VT100 terminal using the TestPad.

**NOTE:**

You do not need to use the on-screen keyboard to type data in the FST-2310 user interface; a virtual keyboard is available whenever typing is required. If you need to type a lot of information, we recommend using a USB keyboard.

**To use the on-screen keyboard**

1 Press the Keyboard key.

   The on-screen keyboard appears.

2 In the active window, tap the field you need to type in.

3 Tap the keys on the on-screen keyboard to type text in the field. To type a symbol, tap the Shift key. The numeric keys change to symbol keys. Type the symbol. The symbol keys change back to numeric keys. You must tap the Shift key each time you need to type a symbol.

After you launch the on-screen keyboard, you can:

- Move the keyboard to a different location by dragging the title bar.
- Minimize the keyboard.
- Maximize the keyboard by pressing the **Keyboard** key.
- Type all capital letters by first tapping the **Caps Lock** key.

**NOTE:**

To optimize performance of the TestPad, secondary features of the on-screen keyboard such as online help have been disabled.

## Sending e-mail

If you purchased the Networking option, you can send e-mail from the TestPad. Before you send e-mail, you must establish a modem dial-out, modem dial-in, or LAN connection to connect to a Simple Mail Transfer Protocol (SMTP) server.

When you compose e-mail, you can:

- Populate the Address Book with e-mail addresses.
- Type messages.
- Attach print files containing test results, test configurations, or histogram data.

**NOTE:**

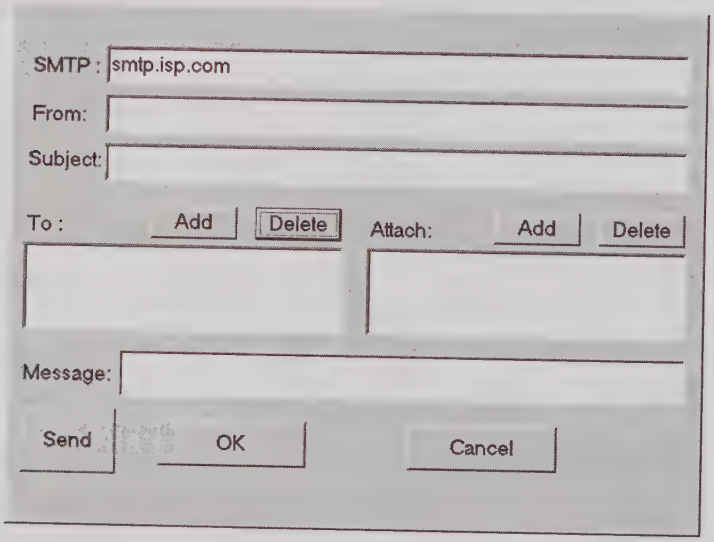
The first time you compose an e-mail on the TestPad, you must specify the address for an SMTP server. Internet Service Providers (ISPs) typically provide an SMTP server. After you specify the SMTP server for the first e-mail, the TestPad stores the server address and provides it automatically each time you compose a new e-mail.

**To send an e-mail**

1 Establish a modem dial-out, modem dial-in, or LAN connection from the TestPad to a network for Internet access.
   - For detailed instructions on establishing a modem dial-out connection, see "Establishing modem dial-out connections" on page 76.
   - For detailed instructions on establishing a modem dial-in connection, see "Establishing modem dial-in connections" on page 78.
   - For detailed instructions on establishing a LAN connection, see "Establishing LAN connections" on page 80.

2 On the TestPad, select the **Tools > Connectivity**.
The Connectivity Menu appears.

3 Select **Email**.
The E-mail dialog box appears.




4 In **SMTP**, type the SMTP server address. The SMTP server address is typically one of the following:
- `smtp.internet provider name.com`
- `smtp.internet provider name.net`

where `internet provider name` represents the name of the company providing your internet service.

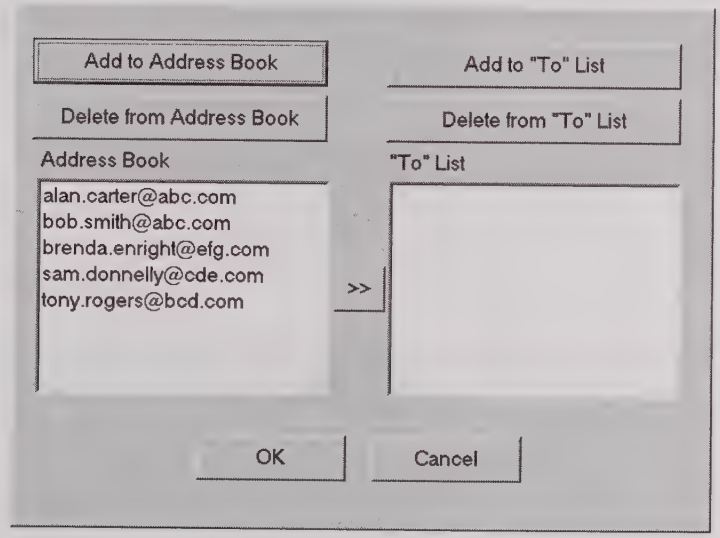
5 In **From**, type the address of an e-mail account you can retrieve messages from.

**NOTE:**

You can not retrieve and read e-mail messages using the FST-2310 user interface; however, if you purchased the Networking and the Web browser option, you can use the browser to access e-mail from an ISP account.

6 In **Subject**, type the subject of the e-mail.

**7** To specify the destination e-mail address, under To:, select **Add**. The Address Maintenance dialog box appears.




If you added addresses to the Address Book previously, the addresses appear in the Address Book.

**8** Do one of the following:

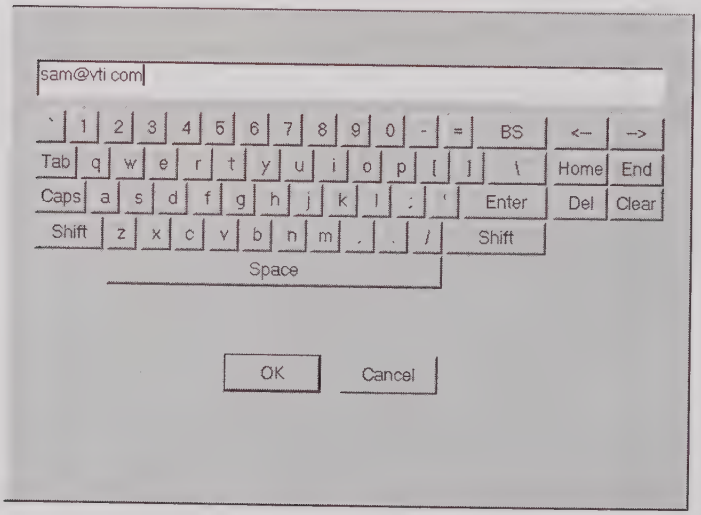
| To... | Do this... |
|---|---|
| Select an existing address from the address book | – Under Address Book, select the address, and then select **>>** to copy the address to the "To" List.<br>– Proceed to step 10. |
| Add a new address to the address book | – Select **Add to Address Book**. A keyboard dialog box appears allowing you to type the new address.<br>– Proceed to step 9. |

| To... | Do this... |
|---|---|
| Add a new address without adding it to the address book | – Select **Add to "To" List**. A keyboard dialog box appears allowing you to type the new address.<br>– Proceed to step 9. |

**9** If you are adding an address, do the following:

**a** Type the address in the field provided. To type the "@" symbol, select the **Shift** key.

The numeric keys change to symbol keys.




**b** Select **OK** to return to the Address Maintenance dialog box.

The new address appears in the Address Book or "To" List.

**10** Select **OK** to return to the E-mail dialog box.

The To: address is automatically populated.

**11** If you want to attach a file to the e-mail, do the following:

**a** Under Attach, select **Add**.

The Select Attachment dialog box appears.

**b** Navigate to the file you want to attach, and then select the file.

**c** Select **OK** to return to the E-mail dialog box.

The file appears in the attached box.

**12** In **Message**, type the message to send with the e-mail, using up to 100 characters.

**13** Select **Send**.

The TestPad sends the e-mail to the address you specified.

## Launching Adobe Acrobat Reader

The FST-2310 provides Adobe Acrobat Reader, which enables you to read `.PDF` files on the TestPad.

**To launch Adobe Acrobat Reader**

– Select the **Tools > Programs > PDFReader**.

Acrobat Reader is launched.

**NOTE:**

To optimize performance of the TestPad, secondary features of Acrobat Reader such as online help have been disabled.

## Launching the VNC Viewer

If you purchased the Networking option, you can run remote applications from the TestPad using the VNC Viewer.

For example, if you have a laptop in your truck which is running a work order application and a VNC server, and you are using the TestPad to test a circuit, after you complete the test, you can close out the work order from the TestPad without returning to your truck. To close the work order, you do the following:

– Establish an 802.11b or Bluetooth connection from the TestPad to the laptop.

– Launch the VNC Viewer on the TestPad.

- View the laptop's work order application.
- Close the work order.

Before you launch the VNC Viewer, you must first establish a modem dial-out, modem dial-in, or LAN connection to the network or laptop the VNC server is running on.

**To launch the VNC Viewer**

1. Establish a modem dial-out, modem dial-in, or LAN connection from the TestPad to the network or laptop the server is running on.
   - For detailed instructions on establishing a modem dial-out connection, see "Establishing modem dial-out connections" on page 76.
   - For detailed instructions on establishing a modem dial-in connection, see "Establishing modem dial-in connections" on page 78.
   - For detailed instructions on establishing a LAN connection, see "Establishing LAN connections" on page 80.
2. Connect a USB keyboard, or press the **Keyboard** key to launch the on-screen keyboard.
3. Select **Tools > Programs > VNC Viewer**.

   The Connection Details dialog box appears.
4. In **VNC server**, type the IP address or computer name of the device running the server.
5. If required, log into the server by typing a password.

The desktop for the device running the VNC server appears.

**NOTE:**

To optimize performance of the TestPad, secondary features of the VNC Viewer such as online help have been disabled.

## Launching the Web browser

If you purchased the Networking and Web browser options, you can launch a Web browser from the FST-2310. You can use the Web browser to view and retrieve intranet or Internet content (such as methods and procedures or engineering records) and configure network equipment.

Before you launch the Web browser, you must first establish a modem dial-out or LAN connection to a network.

**To launch the Web browser**

1 Establish a modem dial-out or LAN connection.
   - For detailed instructions on establishing a modem dial-out connection, see "Establishing modem dial-out connections" on page 76.
   - For detailed instructions on establishing a LAN connection, see "Establishing LAN connections" on page 80.

2 Connect a USB keyboard, or press the **Keyboard** key to launch the on-screen keyboard.

3 Select the **Tools > Programs > Web browser**.

   The Internet Explorer browser appears.

4 Verify your browser connection by typing the address for the site you want to access. If the browser displays the site, the connection is established.

**NOTE:**

To optimize performance of the TestPad, secondary features of the Web browser such as online help have been disabled.

## Emulating a VT100 terminal

If you purchased the VT100 option, the FST-2310 can emulate a VT100 terminal. When you use the TestPad to emulate a VT100 terminal, the TestPad launches a HyperTerminal session. You can use the session to retrieve performance information from network elements and configure the elements.

Before starting VT100 emulation, you must first establish a serial connection to the network element.

**To emulate a VT100 terminal**

1. Establish a serial connection. For detailed instructions on establishing a serial connection, see "Establishing serial connections" on page 74.
2. Press the **Keyboard** key to launch the on-screen keyboard.
3. Select **Tools > Programs > VT100**.

   The HyperTerminal session window appears.
4. The menu for the network element appears after a few seconds. Verify that you can retrieve information from the network element.
5. Use the menu selections to retrieve performance information or configure the element.
6. Select **File > Exit** to end the HyperTerminal session.

**NOTE:**

To optimize performance of the TestPad, secondary HyperTerminal features such as the ability to add a printer and online help have been disabled.

## Using the Remote GUI

If you purchased the Networking option, you can run the TestPad remotely from any device with a Web browser using a VNC session. You can use the Remote GUI to perform any of the tests available for the FST-2310.

When you set up the TestPad, you should specify a Remote GUI password to restrict remote access to the TestPad. For detailed instructions, see "Specifying a Remote GUI password" on page 28.

Before you run the Remote GUI, the TestPad must be connected to the network your PC or laptop is connected to via a modem dial-in, modem dial-out, or LAN connection, or locally via a USB connection. You must also know the IP address or computer name of the TestPad.

## Determining the TestPad's IP address or computer name

**To determine the TestPad's IP address or computer name**

1 On the TestPad, select **Tools** > **Connectivity**.

The Connectivity Menu appears.

2 Select the Network Info tab.

The TestPad's IP address and computer name appear.

## Running the Remote GUI

**To run the Remote GUI**

1 Establish a network connection to the TestPad.

- For detailed instructions on establishing a modem dial-out connection, see "Establishing modem dial-out connections" on page 76.
- For detailed instructions on establishing a modem dial-in connection, see "Establishing modem dial-in connections" on page 78.
- For detailed instructions on establishing a LAN connection, see "Establishing LAN connections" on page 80.

2 From the laptop or PC, launch a Web browser.

3 Type the following address:

`http://ip address:5800`

Where `ip address` is the IP address of the TestPad.

A dialog box appears prompting you to enter the Remote GUI password.

4 Type the Remote GUI password, and then select **OK**.

The Remote GUI for the TestPad appears on your screen.

5 Verify the connection for the Remote GUI by doing the following:

- Using the Remote GUI, change the default configuration for the TestPad.
- Verify the configuration settings in the configuration summary bar of the Remote GUI.

6 To use the Remote GUI:

- Use your mouse to select the elements on the GUI that you would typically "tap" on the TestPad. For example, if you want to select the Setup button to configure a test, using your mouse, simply click the Setup button on the Remote GUI.
- To access the Extended Keys for the TestPad, select the **Tools** button at the bottom right corner of the main screen to display the Tools menu, and then select the command that corresponds to the Extended key on the TestPad.

You are running the Remote GUI.

## Managing files

You can view, run, delete, rename, copy, and paste files (for example, print files and test scripts) on the TestPad from the File Management dialog box. For example, you can rename print files, copy print files to a PCMCIA card, or delete print files. If you establish a network connection, you can also transfer files to and from local drives and FTP servers.

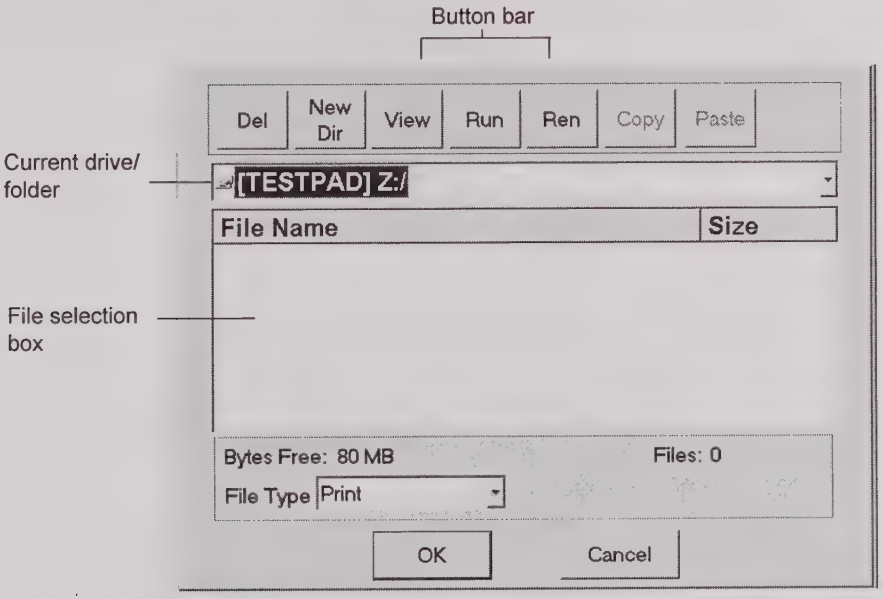
### Selecting files

Before you view, run, rename, copy, or delete a file, you must first select the file.

**To select a file**

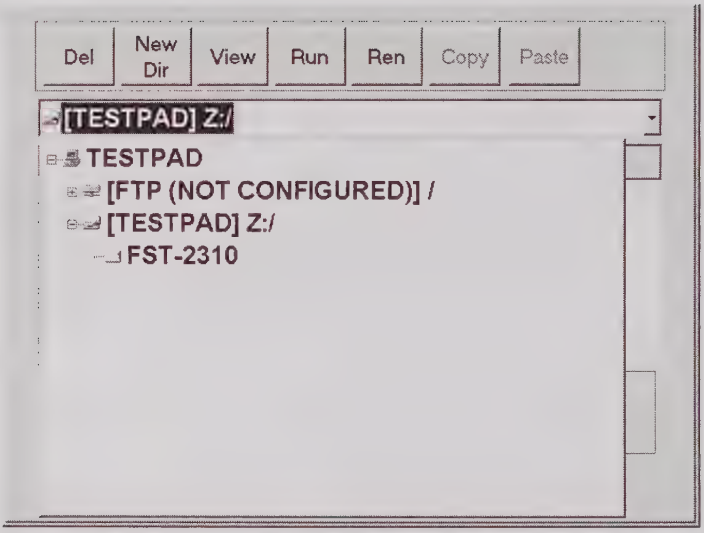
1 Select **Tools > File Management**.

The File Management dialog box appears with the local drive for the TestPad displayed as the current drive.




2 To navigate to the file, select the Current Drive/Folder drop-down arrow.

A drop-down list of drives and folders appears under the current drive/folder.



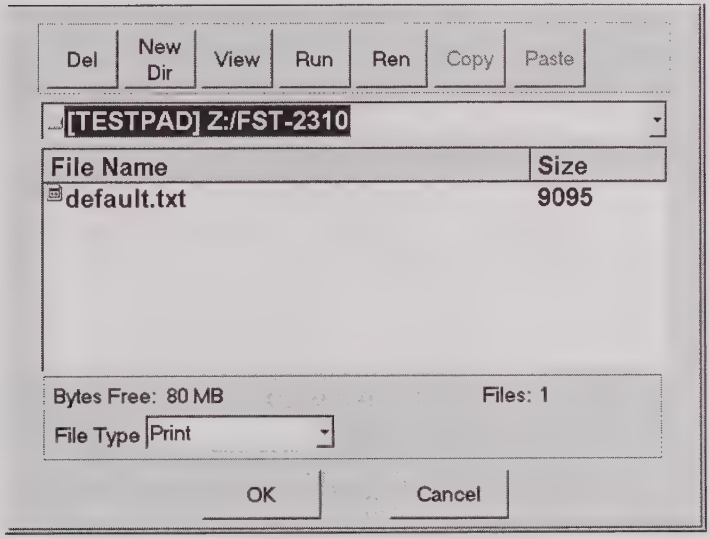

3 Do the following:

**a** Select + to expand a drive or folder.

**b** Tap or click the folder to select the folder with the file.

**c** Tap or click the Current Drive/Folder field.

The drop-down list of drives and folders disappears, the selected folder appears in the Current Drive/Folder field, and the files in the folder appear in the File Selection box.




4 Select a file from the File Selection box.

The file is selected.

## Filtering files

You can filter the files in the File Selection box to display only specific types of files, such as print files or test scripts.

**NOTE:**

The print files you generate and store on the TestPad are stored as text (`.txt`) files.

**To filter the displayed files**

– Select the File Type drop-down arrow, and then select **Print**, **Scripts** or **All**.

## Viewing, running, deleting, or renaming a file

After you select a file, you can view, run, delete, or rename the file.

**To view, run, delete, or rename a file**

1 Select **Tools > File Management**.

The File Management dialog box appears.

2 Navigate to and select the file.

3 Do one of the following:

- To view or run the file, select the corresponding button on the button bar.
- To delete the file, select **Del**. When prompted to confirm the deletion, respond with **OK**.
- To rename the file, select **Ren**, type the new name, and then select **OK**.

## Copying and pasting files

You can copy and paste files on the TestPad to any of the available drives listed on the File Management dialog box, including PCMCIA drives and the FTP drive (which you map to an FTP server). If you want to transfer files to and from an FTP server, you must first establish a network connection, and then log in to the server.

### To copy and paste files

1 Navigate to and select the drive and folder with the file you want to copy.

2 If you selected the FTP drive, log into the FTP server (see "Connecting to an FTP server" on page 68); otherwise, go to step 3.

3 Select the file, and then choose **Copy**.

4 Navigate to the folder you want to paste the file to.

5 If you are copying the file to a folder on the FTP server, log into the FTP server.

6 Select **Paste**.

The file is pasted.

## Connecting to an FTP server

Before you connect to an FTP server from the TestPad, you must establish a modem dial-out, modem dial-in, or LAN connection. After you establish a network connection, you connect to an FTP server by selecting the FTP drive in the File Management dialog box.

**To connect to an FTP site**

1 Establish a modem dial-out, modem dial-in, or LAN connection from the TestPad to the network your device is connected to.
   - For detailed instructions on establishing a modem dial-out connection, see "Establishing modem dial-out connections" on page 76.
   - For detailed instructions on establishing a modem dial-in connection, see "Establishing modem dial-in connections" on page 78.
   - For detailed instructions on establishing a LAN connection, see "Establishing LAN connections" on page 80.

2 Select **Tools > File Management**.

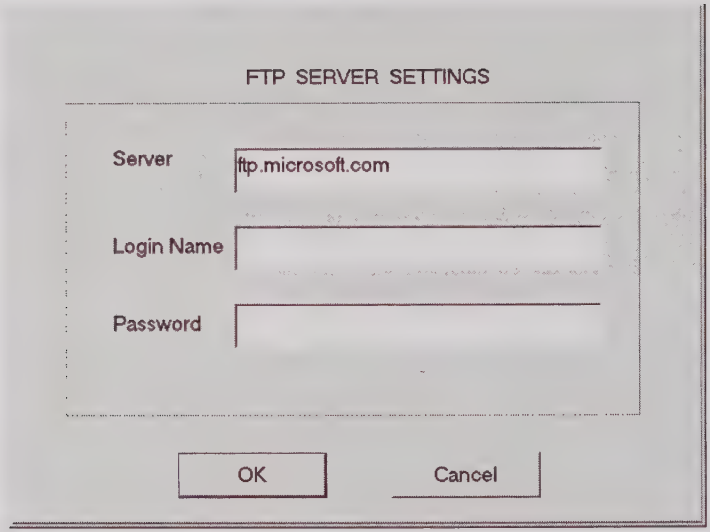
   The File Management dialog box appears.

3 Select the FTP drive. The FTP drive is identified as follows:
   - If this is the first time you are connecting to an FTP server from the TestPad, the drive is identified as:

     `[FTP (Not Configured)]/`
   - If you previously connected to an FTP server from the TestPad, the drive is identified with an FTP prefix, and the name of the last FTP server you connected to. For example, if you connected to Microsoft's FTP server the last time you used the TestPad, the FTP drive is identified as:

     `[FTP.Microsoft.com]/`

   The FTP Server button appears on the button bar, and the FTP Server Settings dialog box appears.




4 Do one of the following:

- If you are connecting to the server displayed in the Server field, proceed to step 5.
- If you are connecting to a different FTP server, tap or click the Server field. An Acterna keyboard appears. Type the address for the server, and then select **OK**.

5 In Login Name and Password, type your login and password, and then select **OK**.

The TestPad connects to the FTP server. You can transfer files to and from the TestPad.

## Connecting to the TestPad's FTP server

You can also log into the TestPad's FTP server from a remote device to transfer files. Before you connect to the TestPad's FTP server, you must establish a modem dial-out, modem dial-in, or LAN connection to the remote device.

**To connect to the TestPad's FTP server**

1 Establish a modem dial-out, modem dial-in, or LAN connection from the TestPad to the network your device is connected to.
   - For detailed instructions on establishing a modem dial-out connection, see "Establishing modem dial-out connections" on page 76.
   - For detailed instructions on establishing a modem dial-in connection, see "Establishing modem dial-in connections" on page 78.
   - For detailed instructions on establishing a LAN connection, see "Establishing LAN connections" on page 80.

2 Launch an FTP session on your device.

3 Connect to the TestPad's FTP server by specifying the following parameters:
   - Server name: `TestPad's computer name` (see "Determining the TestPad's IP address or computer name" on page 63).
   - Login: `acterna`
   - Password: `acterna`

You are connected to the TestPad's FTP server, and you can copy and paste files to and from the TestPad.

# Serial and Network Connections

3

This chapter provides step-by-step instructions for establishing serial and network connections to the TestPad. Topics discussed in this chapter include the following:


- "About serial and network connections" on page 74
- "Establishing serial connections" on page 74
- "Establishing modem dial-out connections" on page 76
- "Establishing modem dial-in connections" on page 78
- "Establishing LAN connections" on page 80
- "Establishing IP socket connections" on page 83

## About serial and network connections

You can establish serial and network connections to the TestPad, enabling you to use a variety of tools such as VT100, the Web browser, VNC Viewer, and FTP. To establish modem dial-out, modem dial-in, LAN, USB direct, and IP socket network connections, you must purchase the Networking option and the associated connectivity accessories required for the connection.

You do not need to purchase the Networking option to establish serial connections to the TestPad; however, you may need to purchase connectivity accessories.

For descriptions of the connectivity accessories offered as accessories by Acterna, see Table 2 on page 8.

## Establishing serial connections

You can establish a serial connection from a laptop or PC to a TestPad using a serial PCMCIA card or a serial cable (connected to the serial port of the Y cable).

After you establish a serial connection, you can do the following:

- Emulate a VT100 terminal (see "Emulating a VT100 terminal" on page 61).
- Issue remote control commands (see the *FST-2310 TestPad Remote Control Reference Guide*).

**To establish a serial connection**

1. Insert the PCMCIA serial card into a PCMCIA card slot on the TestPad, or connect the Y cable to the USB/Serial port.
2. Do one of the following:
   - If you are connecting via a serial PCMCIA card, connect a DB-9 female connector on the serial null modem cable to the connector on the cable attached to the card.
   - If you are connecting via the Y cable, connect a DB-9 female connector on the serial null modem cable to the serial connector of the Y cable.

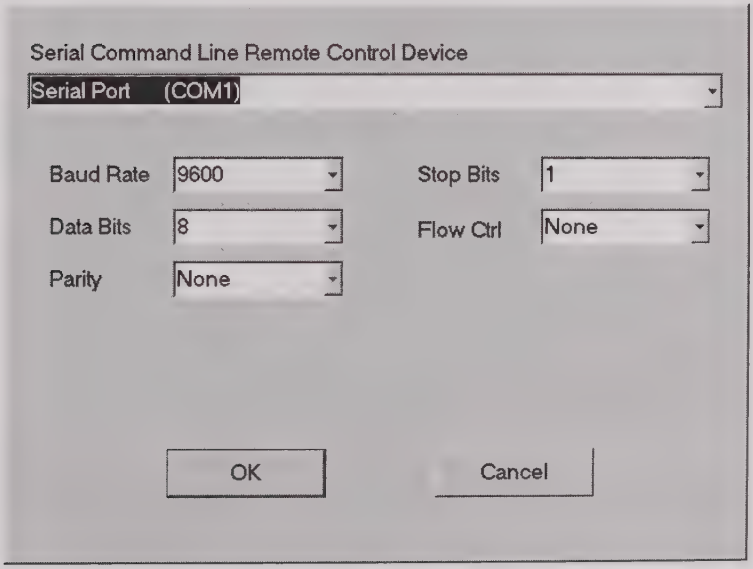
3 Connect the end of the serial null modem cable to the serial port of the laptop or PC.

4 Do one of the following:

- If you are establishing the connection to emulate a VT100 terminal, see "Emulating a VT100 terminal" on page 61.
- If you are establishing the connection to allow a user to issue remote control commands or run the Remote GUI, proceed to step 5.

5 On the TestPad, select **Tools > Connectivity > Serial Remote Command Line**.

The Serial Command Line dialog box appears.




6 If a serial card is inserted in the TestPad and the Y cable is connected to the USB/Serial port, you must select the serial device you are using to establish the connection.

- To establish a connection using a serial card, select **Serial Card**.
- To establish a connection using the serial port of the Y cable, select **Serial Port**.

7 Specify the parameters for the connection, and then select **OK**. Default values for each of the settings are as follows:
   - Baud rate: 9600
   - Data bits: 8
   - Parity: None
   - Stop bits: None
   - Flow control: None

The connection is established.

## Establishing modem dial-out connections

Establishing a modem dial-out connection from the TestPad involves inserting the PCMCIA analog modem card into a PCMCIA card slot, configuring the modem dial-out parameters, and then connecting the PCMCIA card to a phone jack using the supplied RJ-11 phone cable. Finally, you dial out to your Internet Service Provider (ISP). This establishes the modem dial-out connection.

You must have access to a PSTN network for a modem dial-out connection.

After you establish a dial-out connection, you can do the following:

- Launch the Web browser (see "Launching the Web browser" on page 61).
- Run the Remote GUI (see "Using the Remote GUI" on page 62).
- Transfer files using FTP (see "Copying and pasting files" on page 68).
- Establish an IP socket connection to the TestPad (see "Establishing IP socket connections" on page 83), and then issue remote control commands (see the *FST-2310 TestPad Remote Control Reference Guide*).

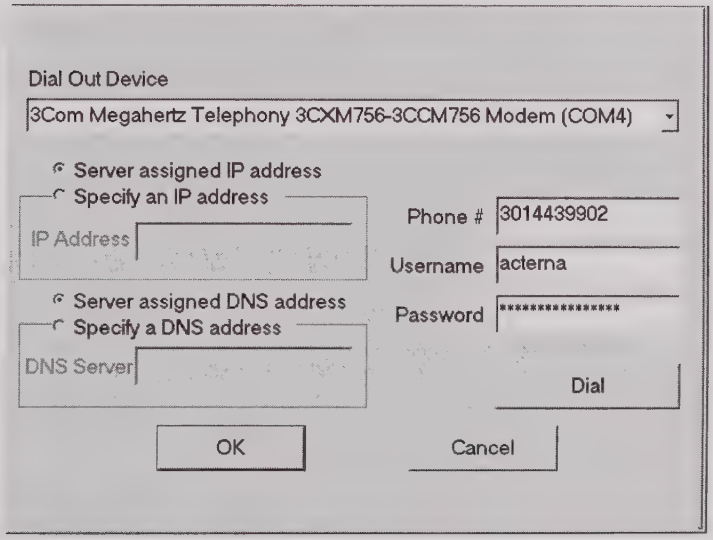
**To establish a modem dial-out connection**

1 Insert the PCMCIA modem card into a PCMCIA card slot on the TestPad.

2 Connect the PCMCIA modem card to a phone jack using the supplied RJ-11 phone cable.

3 On the TestPad, select **Tools > Connectivity > Modem Dial-out Network**.

The Modem Dial-out dialog box appears.




4 Specify the following dial-out parameters:

**a** In **Dial Out Device**, select one of the available devices.

**b** To set the IP address, do one of the following:

- To allow a server to assign the IP address, select **Server assigned IP address**.
- To manually assign the IP address, select **Specify an IP address**, and then type the address in **IP Address**.

**c** To set the DNS address, do one of the following:

- To allow a DNS server to assign the DNS address, select **Server assigned DNS address**.
- To manually assign the DNS address, select **Specify a DNS address**, and then type the address in **DNS Address**.

**d** In **Phone #**, type the dial-out phone number.

**e** In **Username**, type your ISP username.

**f** In **Password**, type your ISP password.

**5** Select **Dial** to establish the connection.

The modem dial-out connection is established.

## Establishing modem dial-in connections

Establishing a modem dial-in connection to the TestPad involves inserting a PCMCIA analog modem card into a PCMCIA card slot on the TestPad, configuring the modem dial-in parameters, and then connecting the PCMCIA modem card to a phone jack using the supplied RJ-11 phone cable. Finally, you dial-in to the TestPad.

You must have access to a PSTN network for a modem dial-in connection.

After you establish a dial-in connection, you can do the following:

- Run the Remote GUI (see "Using the Remote GUI" on page 62).
- Transfer files using FTP (see "Copying and pasting files" on page 68).
- Establish an IP socket connection to the TestPad (see "Establishing IP socket connections" on page 83), and then issue remote control commands (see the *FST-2310 TestPad Remote Control Reference Guide*).

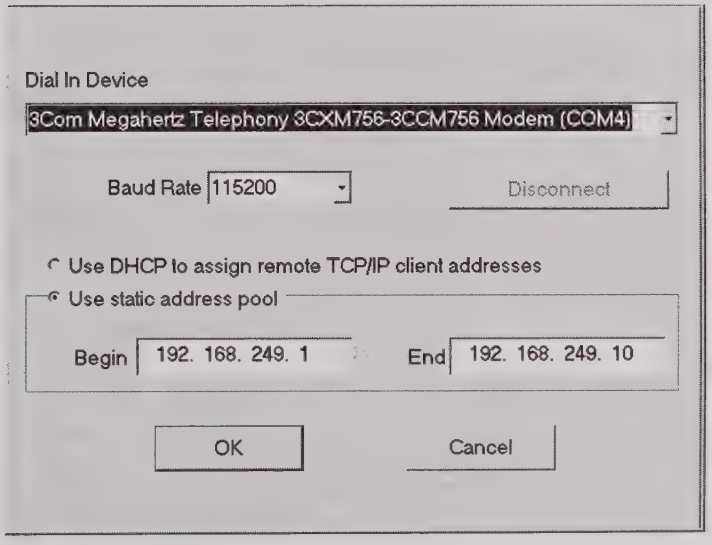
**To establish a modem dial-in connection**

1 Insert the PCMCIA analog modem card into a PCMCIA card slot on the TestPad.

2 Connect the PCMCIA modem card to a phone jack using the supplied RJ-11 phone cable.

3 On the TestPad, select **Tools > Connectivity > Dial-in Network**.

The Dial-in Network dialog box appears.




4 To specify the dial-in parameters, do the following:

**a** In **Dial In Device**, select one of the available dial-in devices.

**b** To set the TCP/IP client address, do one of the following:

- To allow DHCP to assign the address, select **Use DHCP to assign remote TCP/IP client addresses**.
- To use a static address pool, select **Use static address pool**, and then type the range of addresses in the **Begin** and **End** fields.

5 From the remote device, dial into the TestPad. When you are prompted to log on to the TestPad, type the following username and password:

- Username: `acterna`
- Password: `acterna`

Be certain to type the username and password in lowercase.

You are connected to the TestPad.

## Establishing LAN connections

You can establish a LAN connection from the TestPad to a network via an Ethernet connection, or directly to another computer via an Ethernet, 802.11, Bluetooth, or USB direct connection. If you are connecting to a network with Dynamic Host Configuration Protocol (DHCP), you can let DHCP assign a TCP/IP client address, or you can use a static address pool and assign a range of valid addresses.

Table 7 lists the technologies and requirements for network and direct connections.

**Table 7** LAN connections

| Connection | Technology | Requirements |
|---|---|---|
| Network | Ethernet | – Ethernet network<br>– Ethernet PCMCIA card<br>– Ethernet LAN cable |
| Direct | Ethernet | – Ethernet PCMCIA card<br>– Ethernet LAN crossover cable |
| | 802.11b | – 802.11b network<br>– 802.11b PCMCIA card |
| | Bluetooth | – Bluetooth network<br>– Bluetooth PCMCIA card |
| | USB direct | – USB direct connect cable<br>– Y cable |

After you establish a LAN connection to a network or another computer, you can do the following:

- Run the Remote GUI (see "Using the Remote GUI" on page 62).
- Transfer files using FTP (see "Copying and pasting files" on page 68).
- Establish an IP socket connection to the TestPad (see "Establishing IP socket connections" on page 83), and then issue remote control commands (see the *FST-2310 TestPad Remote Control Reference Guide*).
- If you establish a LAN connection to a network, you can also launch the Web browser (see "Launching the Web browser" on page 61).

**To establish a LAN connection**

1 If you are establishing an Ethernet, 802.11, or Bluetooth connection, insert the associated PCMCIA card into a PCMCIA card slot on the TestPad.

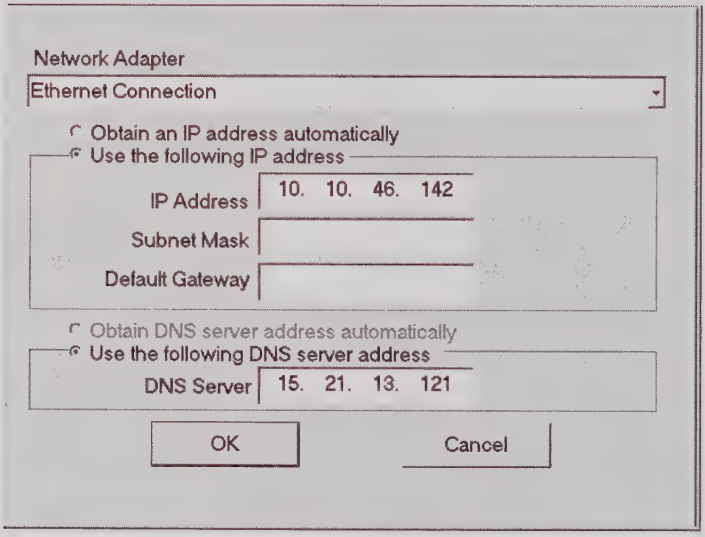
**WARNING: RISK OF DAMAGE TO UNIT**

If you are using Bluetooth to establish a LAN connection, do not remove the Bluetooth PCMCIA card from the TestPad. If the TestPad is configured for a Bluetooth connection, and you turn the TestPad on without a Bluetooth card in a PCMCIA card slot, the TestPad will lock up and may require factory service. We recommend leaving the Bluetooth card in the slot at all times.

2 If you are establishing an Ethernet or direct USB connection, do one of the following:
   - To connect to an Ethernet network, connect the Ethernet LAN cable to the PCMCIA card, and then connect the other end to the network.
   - To connect to a laptop or PC via Ethernet, connect the Ethernet cross-over cable to the PCMCIA card, and then connect the other end to the laptop or PC.
   - To establish a USB direct connection to a laptop or PC, connect the Y cable to the TestPad, and then connect one end of the USB direct connect cable to the USB connector on the Y cable and the other end to the laptop or PC.

3 On the TestPad, select **Tools > Connectivity > Local Area Network**.

The Network Settings dialog box appears.




4 To set the TCP/IP client address, do one of the following:

- To allow DHCP to assign the address, select **Obtain an IP address automatically**.
- To use a static address, select **Use the following IP address**, and then type the IP address in the **IP Address**, **Subnet Mask**, and **Default Gateway** fields.

5 To set the DNS server address, do one of the following:

- To obtain the DNS server address automatically, select **Obtain DNS server address automatically**.
- To use a specific DNS server address, select **Use the following DNS server address**, and then type the address in the **DNS Server** field.

6 If you are connecting via Bluetooth or 802.11b, configure your PC or laptop using the following case-sensitive values:

| Connection | Parameter | Value |
|---|---|---|
| Bluetooth | Friendly Name | `TestPad` |
| 802.11b | SSID | `TestPad` |
| | WEP key | `FST2k` |
| 802.11b (continued) | Static IP address | `192.168.252.2` |

The connection is established.

## Establishing IP socket connections

You can establish an IP socket connection to the TestPad from a laptop or PC. Before you establish an IP socket connection to the TestPad, you must establish a network connection. You should also identify the IP address of the TestPad (see "Determining the TestPad's IP address or computer name" on page 63).

### To establish an IP socket connection

1 On the TestPad, select **Tools > Connectivity > Socket Remote Command Line**.

The Socket Port # dialog box appears.

2 In **Port #**, enter the port number for the connection.

3 Establish a network connection to the TestPad.

- For detailed instructions on establishing a modem dial-out connection, see "Establishing modem dial-out connections" on page 76.
- For detailed instructions on establishing a modem dial-in connection, see "Establishing modem dial-in connections" on page 78.
- For detailed instructions on establishing a LAN connection, see "Establishing LAN connections" on page 80.

4 On the laptop or PC, launch a terminal emulation application (such as HyperTerminal).

5 Connect using the following parameters:
   - TCP/IP (Winsock)
   - Port number: `Port number` (specified in step 2).
   - IP address: `TestPad's IP address or computer name` (see "Determining the TestPad's IP address or computer name" on page 63).

The connection is established.

# Basic Testing

4

This chapter explains basic testing concepts and procedures common to the tests. Topics discussed in this chapter include the following:


– "Running a test" on page 86
– "Managing test configurations" on page 97
– "Running test scripts" on page 99

# Running a test

Running a test involves configuring the test, connecting the TestPad to the test access point, starting the test, and then viewing test results.

**NOTE:**

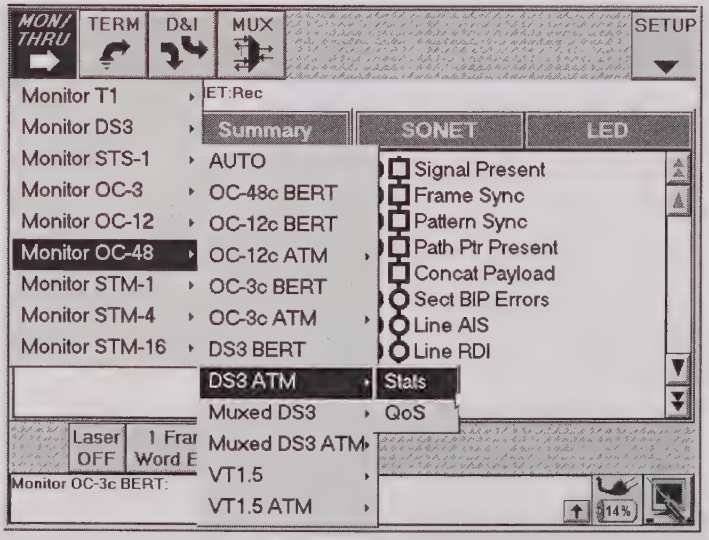
Always configure the TestPad before connecting to the circuit.

## Step 1: Configuring a test

Before you start a test, you need to configure the test and define the circuit you are testing.

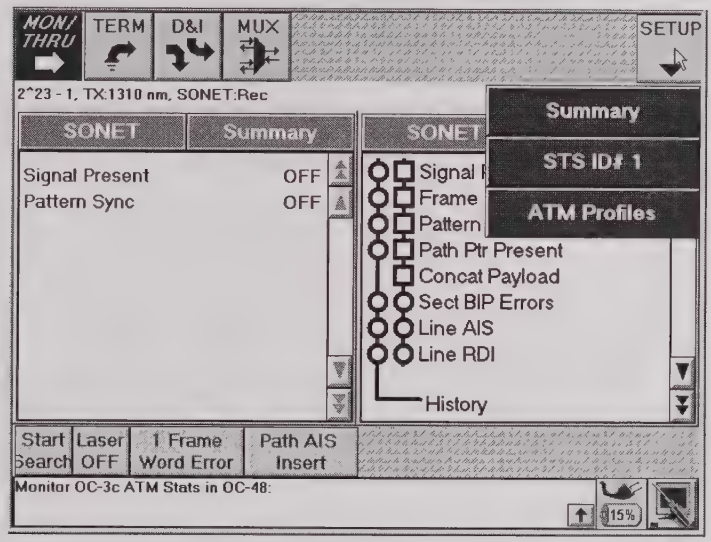
### To configure a test

1 On the Application Button bar, select the mode, rate, and application for the test you want to perform (for example **MON/THRU > Monitor OC-48 > DS3 ATM > Stats**).



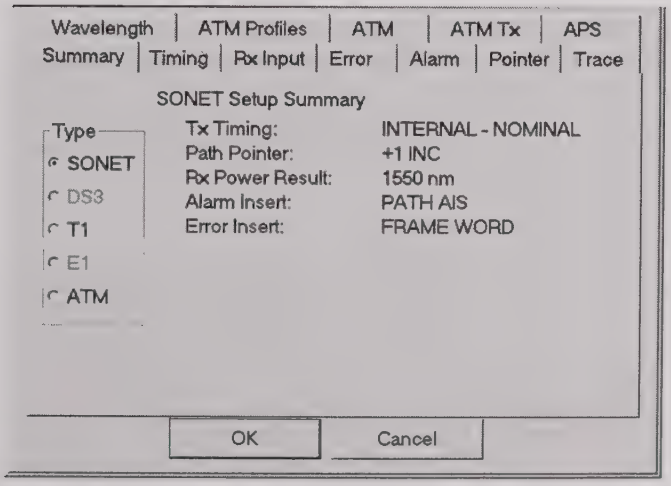

2 To configure the test, select **SETUP**.

A group of Quick Configuration buttons appears.




**3** Select **Summary** to access the setup tabs.

The Summary tab appears with additional setup tabs for the test you selected.



**NOTE:**

Some setup tabs are available for every test, such as Summary, Error, and Pattern. Other tabs only appear for a specific operating mode, rate, or test configuration.

4 Review the existing configuration on the Summary tab.
   - If the existing configuration is correct, select **OK** to return to the main window.
   - If the configuration needs to be modified, proceed to step 5.

5 Select the appropriate setup tabs and specify the parameters required for the test.

6 After you specify the parameters for the test configuration, select **OK** to store the configuration and return to the main window.

The test is configured.

## Step 2: Connecting the TestPad for testing

After you configure a test, you are ready to connect the FST-2310 to the test access point. The following connector layouts are available for the FST-2310:

- Dual DS1 Rx
- Dual or Single DS1/DS3 Rx
- Dual or Single DS1/DS3/STS-1 Rx
- Single OC-3 with Dual or Single DS1/DS3/STS-1 Rx
- Single OC-3/Oc-12 with Dual or Single DS1/DS3/STS-1 Rx
- Single OC-3/OC-12/OC-48 with Dual or Single DS1/DS3/STS-1 Rx

To indicate which connectors to use for a test configuration, the FST-2310 displays yellow active port LEDs next to the physical connectors. For example, if you configure the FST-2310 for a DS3 Terminate test, a yellow LED illuminates next to the DS3/STS-1 Tx connector (see Figure 10).

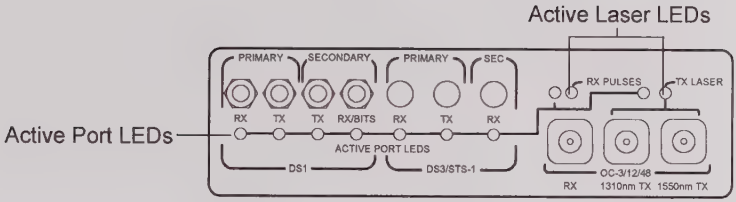



**Figure 10** Active Port and Active Laser LEDs

***Laser safety*** The FST-2310 is equipped with optical connectors for OC-3/12/48 and STM-1/4c/16c testing. Next to each optical connector is a red LED to indicate whether the associated laser is active. The LED next to a transmit connector indicates that the laser is turned on. The LED next to the receive connector indicates that the fiber to the connector carries a live optical signal.

**CAUTION: HAZARDOUS LIGHT EXPOSURE**

Do not look into the laser connectors when the TestPad is powered On. The unused optical connectors should always be covered with the attached caps.

**CAUTION: DAMAGE TO TEST UNIT**

Never loop the high-power Transmit on FST-2310s equipped with OC-48 to the Receive connector of the FST-2310 without adding optical attenuation. This will result in serious damage to the Test-Pad. Optical attenuators are provided with OC-48 FST-2310s for loopback applications.

### *Connecting in Mon/ Thru mode*

In Mon/Thru mode, the TestPad is intended to appear to the network as section terminating equipment or a repeater. The FST-2310 re-transmits what it receives from the input and cleans up framing errors and BIP errors. Figure 11 illustrates the connection required to monitor two DS1 signals.

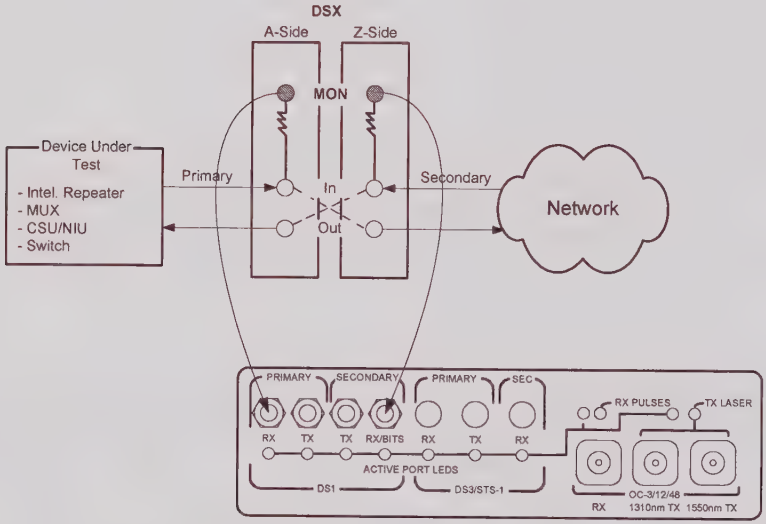



**Figure 11** DSX Mon/Thru mode connection

Figure 12 illustrates the connection required to insert errors and alarms in Thru mode and monitor ATM payloads on an optical signal.

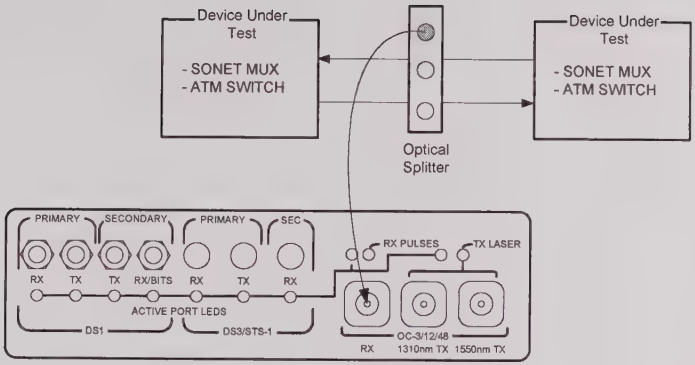



**Figure 12** Optical Mon/Thru connection

**To connect the TestPad in Mon/Thru mode**

– Connect a cable from the appropriate RX connector or connectors on the TestPad (indicated by illuminated yellow LEDs) to the MON connector or connectors of the test access point.

The TestPad is connected.

### *Connecting in Terminate mode*

In Terminate mode, the TestPad generates data for transmission independent of received data. The same mapping, tributary, and BERT pattern selections apply both to the transmit and receive data. Figure 13 illustrates the connection required to terminate a DS1 signal.

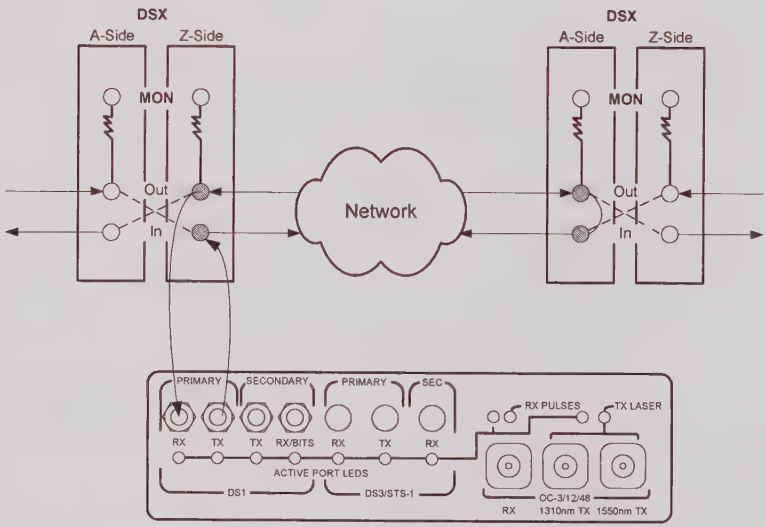



**Figure 13** DSX Terminate mode connection

Figure 14 illustrates the connection required to terminate an optical signal.

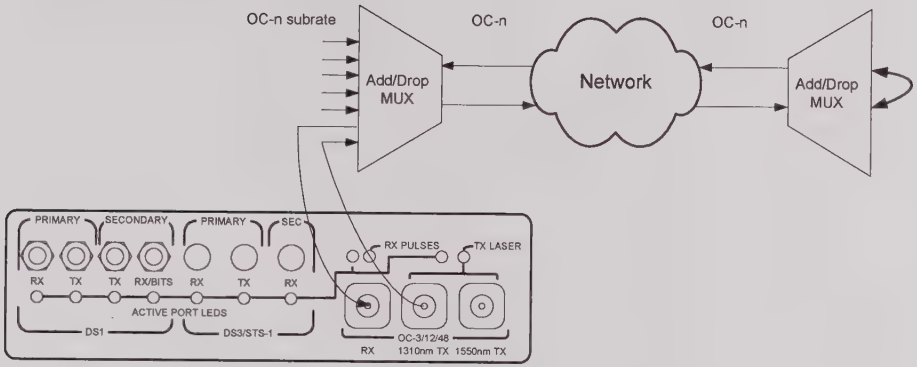



**Figure 14** Optical Terminate mode connection

**To connect the TestPad in Terminate mode**

1. Connect a cable from the appropriate TX connector on the TestPad (indicated by the illuminated yellow LED) to the test access point receive connector.
2. Connect a cable from the appropriate RX connector on the TestPad (indicated by the illuminated yellow LED) to the test access point transmit connector.

The TestPad is connected.

***Connecting in Drop and Insert mode***

In Drop and Insert mode, you can test a lower rate mapping channel within an in-service signal. For example, you can drop and insert a DS0 channel while placing a call. The FST-2310 is placed in line with the circuit and the channel is looped back on each end.

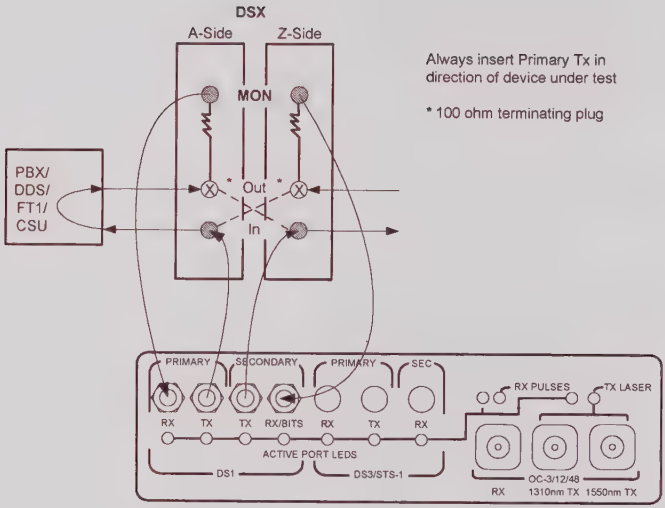



**Figure 15** Drop and Insert mode connection

**To connect the TestPad in Drop and Insert mode**

1 Connect a cable from the appropriate TX connectors on the TestPad (indicated by the illuminated yellow LED) to the receive connectors of the circuit.

2 Connect a cable from the appropriate RX connectors on the TestPad (indicated by the illuminated yellow LED) to the transmit connectors of the circuit.

The TestPad is connected.

***Connecting for a loopback test***

When you perform a loopback test, you can insert errors and loop codes on a circuit and loop them back to the FST-2310 to troubleshoot and sectionalize the circuit. For example, you can generate alternating and latching DDS loop codes on a DDS circuit. Figure 16 illustrates the connection for a loopback test.

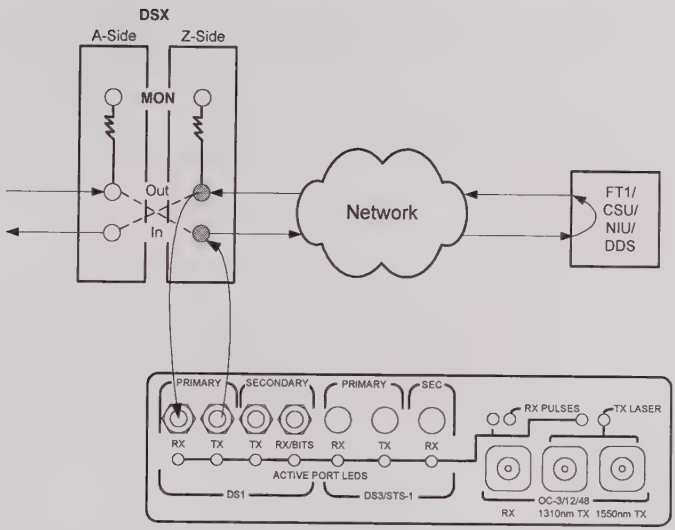



**Figure 16** Loopback test connection

**To connect the TestPad for a loopback test**

1. Connect a cable from the appropriate TX connector on the TestPad (indicated by the illuminated yellow LED) to the receive connector of the circuit.
2. Loopback the far end of the circuit.
3. Connect a cable from the appropriate RX connector on the TestPad (indicated by the illuminated yellow LED) to the transmit connector of the circuit.

The TestPad is connected.

## Step 3: Starting a test

After you configure a test and connect the TestPad to the test access point, you can start the test. Each time you start a test, the TestPad clears existing alarms, and then starts the test.

**To start a test, do one of the following**

- If you are performing the test from the TestPad, press the **Restart** key.
- If you are running the GUI from a remote laptop or PC, select the **Tools** button to display the Tools Menu, and then select **Test Restart** to begin testing.

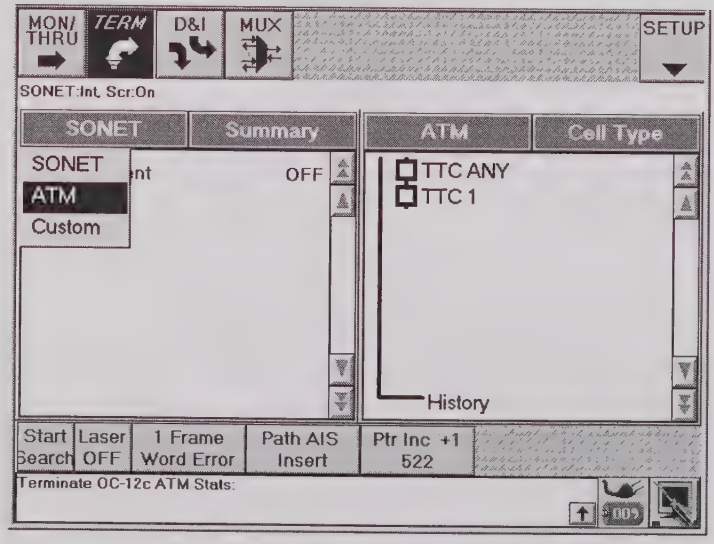
The test starts.

## Step 4: Viewing test results

After you connect the TestPad to the test access point and receive a valid signal, it automatically begins to accumulate results. To view the test results, select a result group and category on one or both results panes. You may want to do this before you connect the TestPad to the test access point.

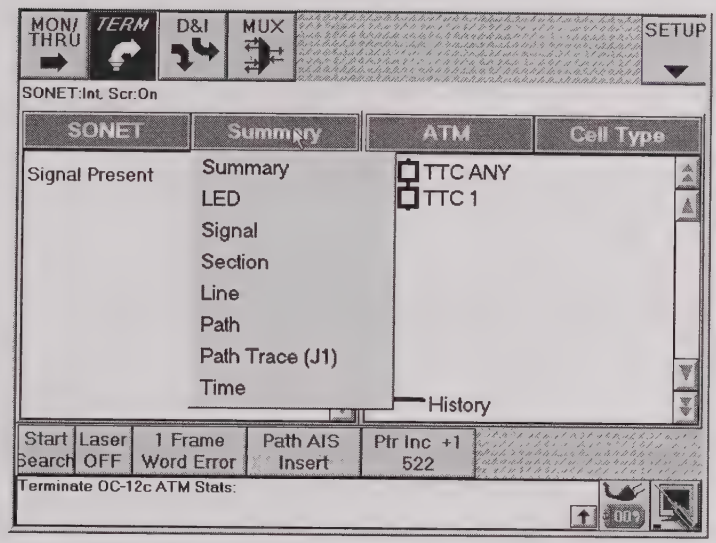
**To view test results**

1 On the left results pane, select the **Result Group** button, and then select the test rate for the results that you want to view.




2 Select the **Result Category** button.

A dropdown list of result categories appears.




3 Select the category for the results that you want to view.

4 Repeat step 2 and step 3 for the right results pane.

You can now view results for two different results categories simultaneously. For result descriptions, refer to Chapter 11 "Test Results".

## Managing test configurations

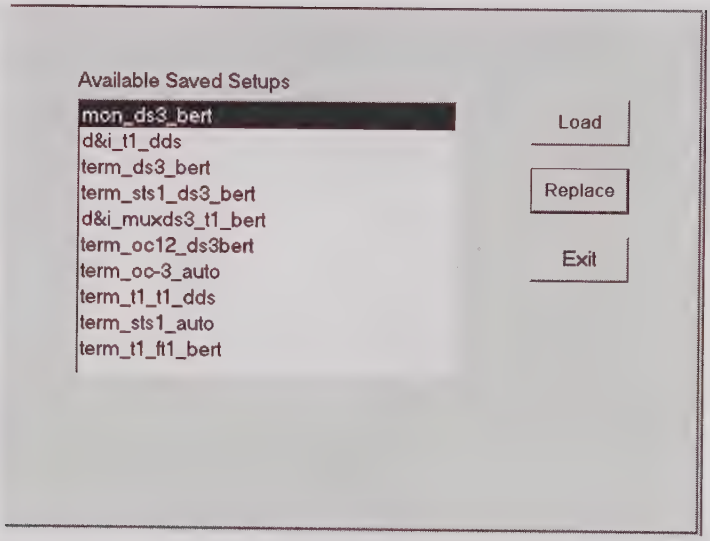
The TestPad allows you to define and store up to ten test configurations (setups). You can then use these test configurations to run your most common tests.

### Storing test configurations

**To store a test configuration**

1 After you configure your test, select the **Tools** button, and then select **Store/Recall Setups**.

The Saved Setups dialog box appears.




2 Select the configuration to replace and select **Replace**.

3 Type the name of the configuration to be saved, and then select **OK**.

The configuration now appears in the list and is stored.

## Loading test configurations

The TestPad allows you to load test configurations from a PCMCIA card.

**To load a test configuration**

1 Select the **Tools** button, and then select **Saved Setups**.
The Saved Setups dialog box appears.

2 Select the configuration you want to load, and then select **Load**.

3 Select **Exit**.

The test is set up using the configuration you selected.

## Running test scripts

If you purchase and install the 2000-SCR automated test script option, you can write test scripts using the Tcl/Tk scripting language to automate your testing processes. A library of automated test scripts is also under development and will be available as an option for the FST-2310.

**NOTE:**

Acterna does not provide Tcl/Tk support. For information on Tcl/Tk scripting, refer to the web sites published by Scriptics.

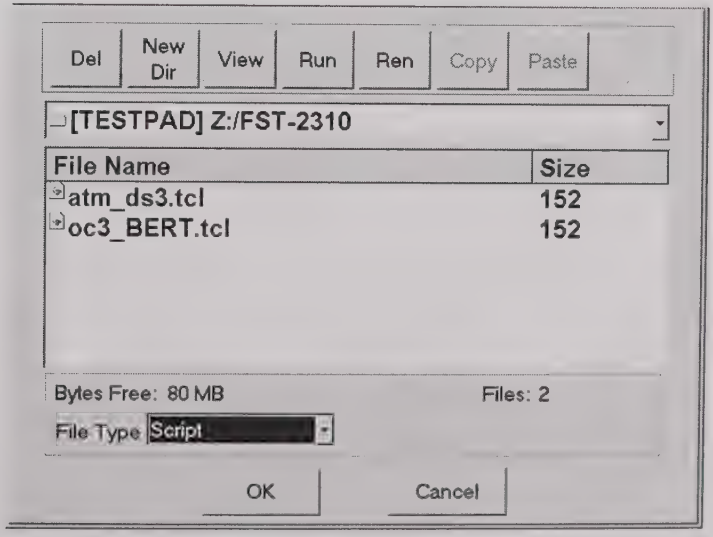
### Running a test script

The AutoMATE option on the Tools Menu provides access to the File Management screen, from which you can run your automated test scripts.

**To run a script**

1 Select the **Tools > AutoMATE**.

The File Management screen appears.




2 Select the script you want to run.

3 Select **Run**.

The script begins to run.

## Viewing, renaming, and deleting script and results print files

You can view, delete, and rename test scripts and results print files from the File Management screen. For detailed instructions on managing files, see "Viewing, running, deleting, or renaming a file" on page 67.

# DS1 Testing

5

This chapter provides step-by-step instructions to perform DS1 testing. Topics discussed in this chapter include the following:


- "About DS1 testing" on page 102
- "T1 testing" on page 102
- "FT1 testing" on page 109
- "DDS testing" on page 112
- "VF channel testing" on page 115
- "Signaling tests" on page 117

## About DS1 testing

Using the FST-2310, you can perform monitor, BERT, Drop and Insert, and loopback tests for T1 and FT1 networks. You can also transmit VF tones and perform signaling tests.

**NOTE:**
When you configure tests to monitor live circuits, you can select the Live Traffic pattern on the Pattern setup tab to disable all pattern related results.

## T1 testing

You can qualify T1 circuit error performance by testing for logic errors, BPVs, frame errors, and CRC errors (if applicable) on T1 lines.

### Monitoring T1 performance

**To monitor T1 performance**

1 On the application button bar, select **MON/THRU > Monitor T1 > T1 BERT**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Chapter C "Setup Descriptions" on page 291 for setup descriptions.

3 Select **OK**.

4 If monitoring a second signal, set the right result group to **T1 Sec**. Set both result categories to **Summary.**

5 Verify that the PRIMARY RX and SECONDARY RX yellow LEDs are illuminated.

6 Connect a cable from the PRIMARY RX jack to the DSX-1 A-Side MON jack.

7 Connect a cable from the SECONDARY RX jack to the DSX-1 Z-Side MON jack. For a sample cabling diagram, see Figure 11 on page 90.

8 Press the **RESTART** key to clear alarms and begin the test.

9 Verify that the green SIGNAL and FRAME LEDs are illuminated.

10 Verify that `Results OK` appears in the results display.

## BER testing

This test allows you to test a T1 circuit for logic errors, BPVs, frame errors, and CRC errors (if applicable) on T1 lines.

### To perform T1 BER testing

1 On the application button bar, select **TERM > Terminate T1 > T1 BERT**.

2 Select **Setup > Summary** and verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select the **Error** tab, and then select **DS1 Logic Error** as the error type. Select **OK** to return to the main screen.

4 Set a result category to **Summary**.

5 Verify that the DS1 PRIMARY TX and DS1 PRIMARY RX yellow LEDs are illuminated.

6 Connect a cable from the DS1 PRIMARY TX jack to the appropriate DSX-1 TX (IN) jack.

7 Connect a cable from the DS1 PRIMARY RX jack to the appropriate DSX-1 RX (OUT) jack. For a sample cabling diagram, see Figure 13 on page 92.

8 Loop the far-end DSX-1.

9 Press the **Restart** key to clear alarms and begin the test.

10 Verify that the green PRI DS1 SIGNAL, FRAME, and PATTERN LEDs are illuminated.

11 Verify that `Results OK` appears in the results display.

12 Select the **DS1 Logic Error** action button five times and verify that five logic errors are received.

## Loopback testing

This test allows you to qualify T1 circuit error performance by testing for logic errors, BPVs, frame errors, and CRC errors (if applicable) on T1 lines.

### *Defining user-programmable loop codes*

You can define and store up to ten user-programmable loop codes and patterns. These codes and patterns are available each time you configure a loopback test on a T1 or DS3 circuit.

**To define a user-programmable loop code**

1 On the application button bar, select **TERM > Terminate T1 > T1 LOOP > User**.

2 Select **Setup > User Code**.

The User Code tab appears. If user-programmable loop codes have already been defined, they appear in the Pattern Name list box.

3 To add a new programmable loop code, select **Add**.

The Enter Pattern Name screen appears.

4 Enter a name for the loop code or pattern using up to 25 characters, and then select **OK** to return to the main screen.

5 Under Pattern Type:

| Select | To |
|---|---|
| Loop Up | Send a loop up command and report if the loop up was successful |
| Loop Dn | Send a loop down command and report if the loop down was successful |
| Other | Send a long, user-defined pattern. If you select Other, the loop code pattern is entered in hexadecimal format and is transmitted in 4 bit multiples; therefore, you can transmit a pattern that is 4, 8, 12, or 16 bits long |

6 If you selected Loop Up or Loop Dn in step 5, under Delivery:

| Select | To |
|---|---|
| Datalink | Send the pattern on a datalink for 3 seconds |
| Payload | Send the pattern on a payload for 20 seconds |

If you selected Other in step 5, the TestPad selects Payload automatically. You can only send user patterns on a payload.

7 Select the arrow to the right of the User Pattern (hex) field. A keypad appears enabling you to enter the pattern.

8 Using the keypad, enter the number for your pattern, and then select **OK** to store the number and return to the User Code tab.

9 Select **OK** to store the code and return to the main screen.

The user-programmable loop code is now available each time you configure a loopback test.

### *T1 loopback testing*

**To perform T1 loopback testing**

1 On the application button bar, select **TERM > Terminate T1 > T1 LOOP**, followed by the appropriate T1 loop type.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select the **Loop Code** tab, and then select the loop code. The available loop codes depend on the loop type you selected in Step 1.

4 Select **OK** to return to the main screen.

5 Set a result category to **Summary**.

6 Press the **RESTART** key to clear alarms and begin the test.

7 Verify that the DS1 PRIMARY TX and PRIMARY RX yellow LEDs are illuminated.

8 Connect a cable from the DS1 PRIMARY TX jack to the appropriate DSX-1 TX (IN) jack.

9 Connect a cable from the PRIMARY RX jack to the appropriate DSX-1 RX (OUT) jack. For a sample cabling diagram, see Figure 16 on page 95.

10 Select **Loop Up**.

11 Verify that the green SIGNAL, FRAME, and PATTERN LEDs are illuminated,

12 Verify that `Results OK` appears on the results display.

13 Send bit errors to verify the loop.

## Loopback testing with intelligent repeaters

The TestPad allows you to sectionalize addressable repeater spans by transmitting appropriate pre-programmed loop codes from the central office (CO).

The Intelligent Repeater Span option provides the intelligent span equipment loop codes used to loop up and loop down individual, addressable office repeaters and line repeaters, or to transmit maintenance switch commands.

The following devices can be armed, disarmed, queried, and looped back when the TB2310-ILE option is installed:

- Teltrend Model 7231LP IOR/ 7239LP ILR Intelligent Repeaters
- Teltrend Model 9132LP IHR Intelligent Repeater
- Teltrend Model 7231LW IOR / 7239LW ILR Intelligent Repeaters
- Teltrend Model 9132LW IHR Intelligent Repeater
- Westell 3130-80 IOR Intelligent Repeater
- Westell 3150-80 ILR Intelligent Repeater
- Westell 3150-81 ILR Intelligent Repeater
- Westell 3150-56 ILR Intelligent Repeater
- Westell 3151-56 ILR Intelligent Repeater
- Westell 3130-56 IOR Intelligent Repeater
- XEL 7853-200 ILR Intelligent Repeater

– Westell 3171 T1 Network Interface and Maintenance System (60 Series)

**To use the Intelligent Repeater Scan**

1 On the application button bar, select **TERM > Terminate T1 > T1 Loop > Repeater**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select the **Timing** tab, and then select **INTERNAL.**

4 Select the **Repeater Commands** tab.

5 Select the Repeater Model and Command, and then select **OK** to return to the main screen.

6 Verify that the PRIMARY TX and PRIMARY RX yellow LEDs are illuminated.

7 Connect a cable from the PRIMARY TX jack to the appropriate DSX-1 IN jack.

8 Connect a cable from the PRIMARY RX jack to the appropriate DSX-1 OUT jack. For a sample cabling diagram, see Figure 16 on page 95.

9 Select the **Arm** action button

10 Select the **Loop Up** action button.

11 Select the **RESTART** key to clear alarms and begin the test.

12 Verify that the green Primary SIGNAL, FRAME, and PATTERN LEDs are illuminated

13 Verify that `Results OK` appears in the results display.

14 Insert one or two errors by selecting the **Start DS1 Logic Error** action button to verify connection.

## Analyzing T1 timing slips

This test allows you to qualify T1 circuit timing slips by testing elapsed time since the test started, as well as the date and time, on T1 lines.

### To analyze T1 timing slips

1 On the application button bar, select **MON/THRU**. Select the signal and then select the mapping for the DS1 within the signal (**VT1.5** or **Muxed DS3 Drop**).

2 Select **T1 BERT**.

3 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

4 Select **OK** to return to the main screen.

5 Verify that the SECONDARY RX/BITS and DSX RX yellow LEDs are illuminated.

6 Connect a cable from the SECONDARY RX/BITS jack to the DS1 BITS Clock or a known good reference signal.

7 Connect a cable from the DSX RX jack to the signal to be tested (see Figure 17).

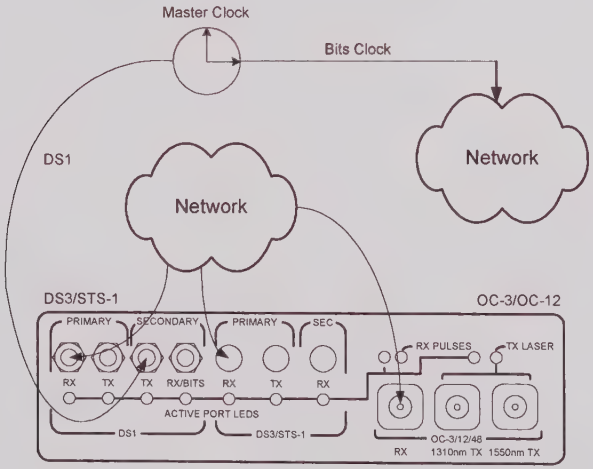



**Figure 17** DS1 timing slips test setup

8 Press the **RESTART** key to clear alarms and begin the test.

9 Verify that the green signal LEDs are illuminated for DS1 and the tested signal (DS3 or SONET).

**10** Set a result group to **T1 Pri**, and then set a category to **Signal > Timing Slips.**

If the signal is error free, `Results OK` appears in the summary results display and 0 appears for the Timing Slip result.

## FT1 testing

The Fractional-T1 (FT1) option enables complete qualification and testing of new FT1 circuits before connecting customer premises equipment. The V.54 FT1 loop code is also added to the feature list and allows for single test set testing of FT1 circuits from a convenient T1 access point. The following tests can be performed:

- Testing aggregate bandwidths on contiguous/non-contiguous channels in 56xN or 64xN format.
- Testing FT1 circuits bandwidths and measuring the round trip path delay of any group of channels.
- Confirming that the FT1 signal is properly received by the network equipment.

### Loopback testing

This test allows you to qualify T1 circuit error performance by testing for logic errors, BPVs, frame errors, and CRC errors (if applicable) on FT1 lines.

**To perform FT1 loopback BER testing**

**1** On the application button bar, select **TERM > Terminate T1 > T1 LOOP > FT1 CSU**.

**2** Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

**3** Select the **Channel** tab and select the FT1 channels and bandwidth (Nx56 or Nx64k).

**4** Select **OK** to return to the main screen.

**5** Set a result category to **Summary**.

6 Verify that the DS1 PRIMARY TX and DS1 PRIMARY RX yellow LEDs are illuminated.

7 Connect a cable from the DS1 PRIMARY TX jack to the appropriate DSX-1 TX (IN) jack.

8 Connect a cable from the DS1 PRIMARY RX jack to the appropriate DSX-1 RX (OUT) jack. Verify T1 Frame SYNC. For a sample cabling diagram, see Figure 16 on page 95.

9 Select **Loop Up**.

10 Press the **RESTART** key to clear alarms and begin the test.

11 Verify that the green PRI DS1 SIGNAL, FRAME, and PATTERN LEDs are illuminated.

12 Verify that `Results OK` appears in the results display.

13 Send bit errors to verify loop.

## Drop and insert testing

This test allows you to qualify FT1 circuit error performance by demultiplexing (dropping) at an intermediate point and entering (inserting) different information on the specific FT1 channels under test on the T1 circuit.

### To perform FT1 drop and insert testing

1 On the application button bar, select **D&I > D&I Loop FT1 CSU**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select the **Channel** tab, and then select the FT1 channels and bandwidth (Nx56 or Nx64k).

4 Select the **Timing** tab, and then select **RECOVERED (loop)**.

5 Select the **Error** tab, and then select **DS1 Logic Error** as the error type.

6 Select **OK** to return to the main screen.

7 If monitoring a second signal, set the right result group to **T1 Sec**. Set both result categories to **Summary**.

8 Verify that the DS1 PRIMARY and SECONDARY RX, and the PRIMARY and SECONDARY TX yellow LEDs are illuminated.

9 Connect a cable from the DS1 PRIMARY and SECONDARY RX jack to the appropriate DSX-1 MON jacks.

**NOTE:**
The PRIMARY RX needs to be connected to the DSX-1 MON point facing the direction of the test.

10 Before patching into the TX jacks, verify that the SIGNAL and FRAME SYNC LEDs are illuminated, and that `Results OK` appears.

11 Connect a cable from the PRIMARY TX jack to the appropriate DSX-1 A-Side (IN) jack. The PRIMARY TX must be cabled to the same side as the PRIMARY RX For a sample cabling diagram, see Figure 15 on page 94.

12 Immediately insert a 100 ohm terminating plug into the Z-Side (OUT) jack, on the opposite side of the DSX.

**NOTE:**
The PRIMARY TX should face the direction of the device under test.

13 Connect a cable from the SECONDARY TX jack to the appropriate DSX-1, Z-Side (IN) jack (the SECONDARY TX must be cabled to the same side as the SECONDARY RX (see Figure 13).

14 Immediately insert a 100 ohm terminating plug into the A-Side jack, on the opposite side of the DSX.

15 Press the **RESTART** key to clear alarms and begin the test.

16 Select **Insert Primary**.

17 Select **Loop Up**.

18 Verify that the green PRI DS1 SIGNAL, FRAME, and PATTERN LEDs are illuminated.

19 Verify that `Results OK` appears in the results display.

20 Select the **DS1 Logic Error** action button five times and verify that five logic errors are received.

# DDS testing

The TestPad allows you to test DDS circuits by performing loopback and drop and insert tests.

## Loopback testing

This test allows you to test Digital Data System (DDS) circuits and generate alternating/latching DDS loop codes for sectionalizing and troubleshooting DDS circuits.

### To perform DDS loopback testing

1 On the application button bar, select **TERM > Terminate T1 > T1 DDS**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select the **Channel** tab, and then select the DDS channel and bandwidth (DS0A56 or DS064).

4 Select the **Loop Code** tab and select the loop code.

If you select DS0-DP Loop Code, select the **DS0-DP** button to select the port number.

5 Select **OK** to return to the main screen.

6 Set a result category to **Summary**.

7 Verify that the DS1 PRIMARY RX and DS1 PRIMARY TX yellow LEDs are illuminated.

8 Connect a cable from the DS1 PRIMARY RX jack to the appropriate DSX-1 RX (OUT) jack.

9 Connect a cable from the DS1 PRIMARY TX jack to the appropriate DSX-1 TX (IN) jack For a sample cabling diagram, see Figure 16 on page 95.

10 Verify that the green SIGNAL and FRAME SYNC LEDs are illuminated.

11 Select **Loop Up**.

12 Press the **RESTART** key to clear alarms and begin the test.

13 Verify that the green PRI DS1 SIGNAL, FRAME, and PATTERN LEDs are illuminated.

14 Verify that `Results OK` appears in the results display.

15 Send bit errors to verify the loop.

## Drop and insert testing

You can test DDS circuits from a T1 access point and generate alternating/latching DDS loop codes without removing the other T1 channels from service.

**To perform DDS drop and insert testing**

1 On the application button bar, select **D&I > D&I T1 DDS**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select the **Channel** tab and select the FT1 channels and bandwidth (Nx56 or Nx64k).

4 Select the **Loop Code** tab and select the DDS piece of equipment to be looped. If you select DS0-DP, select the **DS0-DP** button and select the DS0-DP address.

5 Select the **Error** tab and select **DS1 Logic Error** as the error type.

6 Select **OK** to return to the main screen.

7 Set the left result category to **Summary** and the right result category to **Channel**.

8 Verify that the DS1 PRIMARY and SECONDARY RX, and the PRIMARY and SECONDARY TX yellow LEDs are illuminated.

9 Connect a cable from the DS1 PRIMARY and SECONDARY RX jack to the appropriate DSX-1 MON jacks.

**CAUTION: TRAFFIC INTERRUPTION**

Never insert the terminating plug first. The PRIMARY RX must be in the DSX facing the direction of the device under test.

10 Verify that the SIGNAL and FRAME SYNC LEDs are illuminated, and that `Results OK` appears in the Result Display window before patching into the TX jacks.

11 Connect a cable from the PRIMARY TX jack to the appropriate DSX-1 A-Side (IN) jack, which is the same side of the DSX as the PRIMARY RX (OUT).

12 Immediately insert a 100 ohm terminating plug into the Z-Side (OUT) jack on the opposite side of the DSX.

**CAUTION: TRAFFIC INTERRUPTION**

Never insert the terminating plug first. The PRIMARY RX must be in the DSX facing the direction of the device under test.

13 Connect a cable from the SECONDARY TX jack to the appropriate DSX-1 Z-Side (IN) jack on the same side of the DSX-1 as the SECONDARY RX For a sample cabling diagram, see Figure 15 on page 94.

14 Immediately insert a 100 ohm terminating plug into the Z-Side jack, which is the OUT Jack on the opposite side of the DSX.

15 Press the **RESTART** key to clear alarms and begin the test.

16 Verify that the green SIGNAL and FRAME SYNC LEDs are illuminated.

17 Select **Insert Primary**.

18 Select **Loop Up**.

19 Verify that the green PRI DS1 SIGNAL, FRAME, and PATTERN LEDs are illuminated and that `Results OK` appears in the results display.

20 Select the **DS1 Logic Error** action button five times and verify that five logic errors are received.

## VF channel testing

The VF option allows you to monitor DS0 (VF) channels out of a DS1 signal. These tests allow you to:

- Qualify voice-grade VF circuits by measuring Signal-to-Noise ratio (S/N), C-Message, and C-Notch.
- Qualify data-grade VF circuits with the 3 kHz Flat, and 3 kHz Notch filters.
- Perform automated frequency sweeps.

### Drop and monitor testing

The following test enables you to drop and monitor voice frequency channels from a DS1 signal.

**To perform a drop and monitor test**

1. On the application button bar, select **MON/THRU > Monitor T1 > T1 VF**.
2. Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.
3. Select **OK** to return to the main screen.
4. If monitoring a second line, set the right result group to **T1 Sec**. Set both result categories to **Channel**.
5. Verify that the PRIMARY and SECONDARY DS1 RX yellow LEDs are illuminated.
6. Connect a cable from the PRIMARY and SECONDARY DS1 RX jack to the appropriate DSX monitor point For a sample cabling diagram, see Figure 11 on page 90.
7. Press the **RESTART** key to clear alarms and begin the test.
8. Verify that the green SIGNAL and FRAME LEDs are illuminated.
9. Verify that `Results OK` appears in the results display.
10. To test another channel, select **Setup**, and then select **DS0# X/X**.

## Transmitting VF tones

The following test enables you to transmit voice frequency tones on a DS1 signal, while terminating the T1 circuit.

### To transmit VF tones

1. On the application button bar, select **TERM > Terminate T1 > T1 VF**.
2. Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.
3. Select the **Channel** tab, and then select the channel to transmit the tone.
4. Select the **VF** tab.

   The VF Tone Setup tab appears.
5. Select the tone to be transmitted.
6. Select **OK** to return to the main screen.
7. Set the left result category to **Summary** and the right result category to **Channel**.
8. Verify that the DS1 PRIMARY RX and DS1 PRIMARY TX yellow LEDs are illuminated.
9. Connect a cable from the DS1 PRIMARY RX jack to the appropriate DSX-1 RX (OUT) jack.
10. Connect a cable from the DS1 PRIMARY TX jack to the appropriate DSX-1 TX (IN) jack (see Figure 18 on page 117).

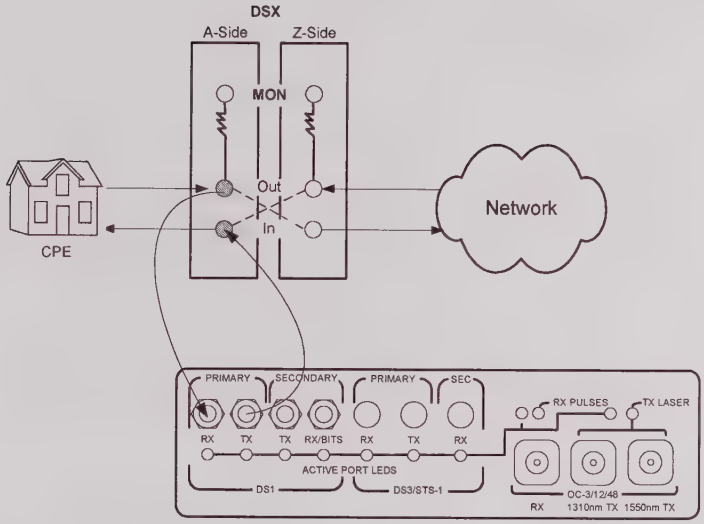



**Figure 18** VF tone insertion connection

**11** Loop the end of the network to be tested.

**12** Select the **RESTART** key to clear alarms and begin the test.

**13** Verify that the green PRI DS1 SIGNAL, and FRAME LEDs are illuminated.

**14** Observe the channel results in the right results pane.

**15** To test another channel, select **Setup**, and then select **DS0# X/X**.

## Signaling tests

This option enables you to test the ability of a switch/PBX to handle incoming calls and allows you to emulate switch-to-switch communications. You can place, receive, and monitor calls over several trunk types. Features include Send/Receive DP, DTMF, and MF digits to/from switches and PBXs. You can also measure inter-digit delay and digit/tone duration.

## Monitoring A/B/C/D signaling bits

This test allows you to view the signaling bits for all of the 24 channels for both the primary and secondary lines, simultaneously.

**To monitor A/B/C/D signaling bits**

1. On the application button bar, select **Mon/Thru > Monitor T1 > T1 VF**.
2. Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.
3. Select **OK** to return to the main screen.
4. Set the left result group to **T1 Pri** and the right result group to **T1 Sec**.
5. Set both result categories to **Traffic**.
6. Connect two cables, one from the PRIMARY RX jack, and the other from the SECONDARY RX jack to the DSX-1 MON access point.
7. Select the **RESTART** key to clear alarms and begin the test.
8. Verify that the green SIGNAL and FRAME LEDs are illuminated. Observe all 24 channels for Primary and Secondary.

## Signaling monitor (call capture)

This test allows you to capture a call.

**To capture a call capture**

1. On the application button bar, select **MON > Monitor T1 > Monitor Call**.
2. Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.
3. Select the **Trunk** tab and select the trunk type. If you select Loop Start or Ground Start, specify the circuit equipment.
4. Select the call source.

5 Select the **Channel** tab, and then select the DS0 channel that you want to monitor. Select **OK**.

6 Set both result groups to **Primary**.

7 Set the left result category to **Call Sig** and the right result category to **Traffic**.

8 Connect two cables, one from the PRIMARY T1 interface, and the other from the SECONDARY T1 interface to the DS1 test access point (DSX-1 patch panel).

9 Press the **RESTART** key to clear alarms and begin the test.

10 Verify that the green SIGNAL and FRAME LEDs are illuminated. Observe the signaling activities in the Result Display window.

## Emulating a PBX/ switch to originate a call

This test allows you to originate a call while terminating the T1 circuit.

**To emulate a PBX/switch to originate a call**

1 On the application button bar, select **TERM > Terminate T1 > Place Call**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select the **Channel** tab, and then choose the T1 channel (DS0) on which to transmit the call.

4 Select the **Trunk** tab.

- Under Trunk Type Emulation, select the circuit equipment for the trunk type.
- Under Address, select the address (MF, DP, or DTMF).

5 Select **OK** to return to the main screen.

6 Connect a cable from the PRIMARY RX jack to the OUT jack of the DSX-1. Connect a cable from the PRIMARY TX jack to the IN jack of the DSX-1.

7 Press the **RESTART** key to clear alarms and begin the test.

8 Verify that the green SIGNAL and FRAME LEDs are illuminated.

9 Set a result category to **Call Sig**.

10 Verify that `On Hook` appears in the results display.

11 Select **Off Hook**.

12 Verify that `Off Hook` appears in the results display, followed by `WINK` (on standard E&M trunks) or `Dial Tone` (on Loop and Ground Start trunks).

13 Select **Enter Dial**, and dial the test number on the numeric keypad.

14 Select **Push 2 Talk** or use the handset when you want to talk into the TestPad (keep button pressed while talking).

15 Select **On Hook** to complete the call.

16 Select **DS0# X/X** to select another DS0 channel to test.

## Emulating a PBX switch to terminate a call

The following test enables the TestPad to terminate a call while terminating the T1 under test.

**To emulate a PBX switch to terminate a call**

1 On the application button bar, select **TERM > Terminate T1 > Receive Call**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select the **Channel** tab to choose the T1 channel (DS0) on which to receive the call.

4 Select the **Trunk** tab, and then select the trunk type. If you select Loop Start or Ground Start, specify the circuit equipment.

5 Connect a cable from the PRIMARY TX jack to the IN jack of the DSX-1. Connect a cable from the PRIMARY RX jack to the OUT jack of the DSX-1.

6 Press the **RESTART** key to clear alarms and begin the test.

7 Verify that the green SIGNAL and FRAME LEDs are illuminated.

8 Set a result category to **Call Sig**.

9 Verify that `On Hook` appears in the results display.

10 When a call is placed, select **Off Hook** to answer, and then **Push 2 Talk** to establish voice connection.

11 Observe call sequence events as the call is established.

## T1 drop and insert testing when placing a call

The following test enables drop and insert testing when placing a call.

**To perform drop and insert to place a call**

1 On the application button bar, select **D&I > D&I Place Call**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select the **Trunk** tab, and then select the standard trunk type.

4 Select the type of circuit equipment (Loop Start or Ground Start) for the source of the call.

5 Select the address type.

6 Connect a cable from the PRIMARY RX jack to the appropriate DSX-1 A-Side MON jack. For a sample cabling diagram, see Figure 15 on page 94. The PRIMARY RX must be in the DSX jack facing the direction of the device under test.

7 Connect a cable from the SECONDARY RX jack to the appropriate DSX-1 Z-side MON jack.

8 Check for FRAME and SIGNAL SYNC.

9 Connect a cable from the PRIMARY TX jack to the appropriate DSX-1 A-side (IN) jack.

10 Insert a 100 ohm terminating plug into the DSX-1 Z-side (OUT) jack. This connection should be on the same side of the DSX as the PRIMARY RX.

**CAUTION: TRAFFIC INTERRUPTION**

Never insert the terminating plug first. The PRIMARY RX must be in the DSX facing the direction of the device under test.

**11** Press the **RESTART** key to clear alarms and begin the test.

**12** Verify that the Primary and Secondary SIGNAL and FRAME LEDs are illuminated. Verify that `Results OK` appears in the results display.

**13** Set the left result category to **Call Sig** and the right result category to **Traffic**.

**14** Select **Insert Primary** and verify that `On Hook` appears in the results display.

**15** Select **Off Hook** and verify that `Off Hook` appears in the results display, followed by `WINK` (on standard E&M trunks) or `Dial Tone` (on Loop and Ground Start trunks).

**16** Select **Enter Dial** and dial the test number.

**17** Select **Push 2 Talk** and speak into the microphone to establish a voice path.

**18** Select **On Hook** to complete the call.

**19** Select **DS0# X/X** to select another DS0 channel to test.

- Repeat the procedure from step 11 to continue testing remaining DS0 channels.
- Disconnect from the circuit in the reverse order to prevent service disruption.

# DS3 Testing

6

This chapter provides step-by-step instructions to perform DS3 testing. Topics discussed in this chapter include the following:


- "About DS3 testing" on page 124
- "Monitoring DS3 performance" on page 124
- "DS3 BER testing" on page 125
- "Loopback testing" on page 126
- "Drop and insert testing" on page 127

## About DS3 testing

Using the FST-2310, you can qualify DS3 circuits with BERT patterns for both M13 and C-bit framing, and insert patterns on one or all DS1 channels. The TestPad also enables you to drop DS1 and DS0 channels from DS3 signals to test and monitor, drop and insert DS1 signals at the DS1 rate from a DS3 signal, and verify frame synchronization on DS3 lines.

**NOTE:**
When you configure tests to monitor live circuits, you can select the Live Traffic pattern on the Pattern setup tab to disable all pattern related results.

## Monitoring DS3 performance

The following test enables you to monitor DS3 signals.

**To monitor DS3 performance**

1 On the application button bar, select **MON/THRU > Monitor DS3 > DS3 BERT**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select **OK** to return to the main screen.

4 If monitoring a second signal, set the right result group to **DS3 Sec**. Set both result categories to **Summary**.

**NOTE:**
The Dual RX option must be present to use the Secondary DS3 receiver.

5 Verify that the DS3 PRIMARY RX and the DS3 SECONDARY RX yellow LEDs are illuminated.

6 Connect a cable from the DS3 PRIMARY RX jack to the DSX-3 A-SIDE MON jack.

7 Connect a cable from the DS3 SECONDARY RX jack to the DSX-3 Z-SIDE MON jack For a sample cabling diagram, see Figure 11 on page 90.

8 Press the **RESTART** key to clear alarms and begin the test.

9 Verify that the green SIGNAL and FRAME LEDs are illuminated.

10 Verify that `Results OK` appears in the results display.

## DS3 BER testing

This test allows you to qualify DS3 circuits with BERT patterns for both M13 and C-bit framing, insert patterns on one or all DS3 channels, drop DS1 and DS0 channels from DS3 signals to test and monitor, and verify frame synchronization on DS3 lines.

### To perform DS3 BER testing

1 On the application button bar, select **TERM > Terminate DS3 > DS3 BERT**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select the **Error** tab, and then select **DS3 Logic** as the error type.

4 Select **OK** to return to the main screen.

5 Set a result category to **Summary**.

6 Verify that the DS3 PRIMARY RX and the DS3 PRIMARY TX yellow LEDs are illuminated.

7 Connect a cable from the DS3 PRIMARY RX jack to the appropriate side of the DSX-3 RX (OUT) jack.

8 Connect a cable from the DS3 PRIMARY TX jack to the appropriate DSX-3 TX (IN) jack For a sample cabling diagram, see Figure 13 on page 92.

9 Loop back the far-end DSX-3 (either manually or by using the DS3 FEAC loop code).

10 Press the **RESTART** key to clear alarms and begin the test.

11 Verify that the green PRI DS3 SIGNAL, FRAME, and PATTERN LEDs are illuminated.

12 Verify the `Results OK` appears in the results display.

13 Select the **Single DS3 Logic Error** action button five times. Verify that five logic errors are received.

## Loopback testing

This test allows you to qualify DS3 circuit error performance by testing for logic errors, BPVs, frame errors, and CRC errors (if applicable) on T1 lines.

When you configure DS1 loopback tests from a DS3 access, you can define user-programmable loop codes and patterns to select for your test. See "Defining user-programmable loop codes" on page 104 for step-by-step instructions on defining these codes.

**To perform DS1 loopback testing from a DS3 access**

1 On the application button bar, select **TERM > Terminate DS3 > Muxed DS3 >T1 LOOP** followed by the appropriate loop code.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select the **Loop Code** tab, and then select the loop code.

**NOTE:**
Depending upon the loop code you selected in Step 1, the Loop Code tab displays the possible selections which pertain to that menu selection.

4 Select **OK** to return to the main screen.

5 Set a result category to **Summary**.

6 Select the **RESTART** key to clear alarms and begin the test.

7 Verify that the DS3 PRIMARY RX and the DS3 PRIMARY TX yellow LEDs are illuminated.

8 Connect a cable from the DS3 PRIMARY RX jack to the appropriate side of the DSX-3 RX (OUT) jack.

9 Connect a cable from the DS3 PRIMARY TX jack to the appropriate DSX-3 TX (IN) jack (for a sample cabling diagram, see Figure 13 on page 92).

10 Select **Loop Up**.

11 Verify that the green SIGNAL, FRAME, and PATTERN LEDs are illuminated.

12 Verify that `Results OK` appears on the results display.

13 Send bit errors to verify the loop.

## Drop and insert testing

This test enables you to non-intrusively test one DS1 within an in-service DS3 signal from a DS3 access point. You can drop and insert a DS1 in a muxed DS3 signal when you perform T1 BER tests and T1 loopback tests.

### To perform DS1 drop and insert testing

1 On the application bar, select **D&I > D&I Muxed DS3 > T1 Loop**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select the **Channel** tab, and then select the DS1 channel to drop from the muxed DS3 signal.

4 Select the **Loop Code** tab, and then select or specify the loop code to insert.

5 Set the left result category to **Summary**, and then set the right result category to **Channel**.

6 Verify that the DS3 PRIMARY and SECONDARY RX, and the PRIMARY TX yellow LEDs are illuminated.

**NOTE:**
This cabling configuration and analysis method differ from the T1 D&I applications explained in Chapter 4. In a DS3 D&I test, the channel under test is dropped from the Primary RX and inserted to the Primary TX. The transmitted signal that is looped back by the terminating equipment is analyzed on the Secondary RX channel.

7 Connect a cable from the PRIMARY DS3/STS-1 RX jack to the Z-Side DSX-3 MON jack.

Connect a cable from the SECONDARY DS3/STS-1 RX jack to the A-Side DSX-3 MON jacks (see Figure 19).

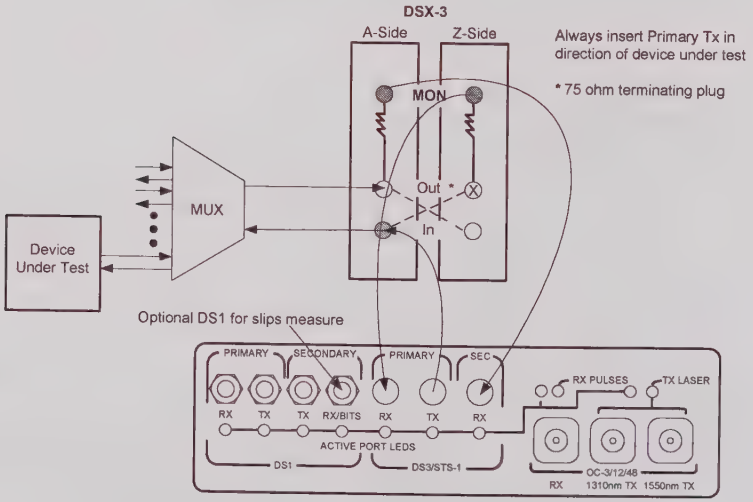



**Figure 19** DS1 and DS3 drop and insert test setup

**CAUTION:**
Service will be disrupted if cables are not connected properly. The PRIMARY RX must be in the DSX away from the device under test.

8 Verify that the SIGNAL and FRAME SYNC LEDs are illuminated, and that `Results OK` appears in the Result Display window before patching into the TX jack.

9 Connect a cable from the PRIMARY DS3/STS-1 TX jack to the appropriate DSX-3 A-Side (IN) jack, which is the same side of the DSX as the SECONDARY RX.

**10** Immediately insert a 75 ohm terminating plug into the Z-Side (OUT) jack.

**11** Select **Insert Primary**.

**12** Select **Loop Up**.

**13** Press the **RESTART** key to clear alarms and begin the test.

**14** Verify that the green SIGNAL, FRAME, and PATTERN SYNC LEDs are illuminated.

**15** Verify that `Results OK` appears in the Result Display window.

**16** Send bit errors to verify the loop.

**17** View the results of your test.

# SONET Testing

7

This chapter provides step-by-step instructions to perform SONET testing. Topics discussed in this chapter include the following:


- "About SONET testing" on page 132
- "Monitoring STS-1 performance" on page 132
- "STS-1 BER testing" on page 133
- "Monitoring VT1.5 signals" on page 134
- "Monitoring OC-3/OC-12/OC-48 performance" on page 135
- "OC-3/OC-12/OC-48 BER testing" on page 136
- "Measuring optical power" on page 137
- "Verifying APS switchover time" on page 138
- "Viewing overhead bytes" on page 140
- "Manipulating overhead bytes" on page 142
- "SONET drop and insert testing" on page 144
- "About SDH testing" on page 145

## About SONET testing

Using the FST-2310, you can monitor and perform BER tests for STS-1 and OC-3/OC-12/OC-48 networks. You can also measure optical power and verify APS switchover time for all interfaces.

**NOTE:**
When you configure tests to monitor live circuits, you can select the Live Traffic pattern on the Pattern setup tab to disable all pattern related results.

## Monitoring STS-1 performance

The following test enables you to monitor STS-1 signals for framing, path pointer adjustments, and BPVs.

**To monitor STS-1 performance**

1 On the application button bar, select **MON/THRU > Monitor STS-1** and the appropriate payload mapping.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select **OK** to return to the main screen.

4 If monitoring a second signal, set the right result group to **SONET Sec**. Set both result categories to **Summary**.

**NOTE:**
The Dual RX option must be present to use the Secondary STS-1 receiver.

5 Verify that the STS-1 PRIMARY and SECONDARY RX yellow LEDs are illuminated.

6 Connect a cable from the STS-1 PRIMARY RX jack to the STS-1 PRIMARY MON jack.

7 Connect a cable from the STS-1 SECONDARY RX jack to the STS-1 SECONDARY MON jack For a sample cabling diagram, see Figure 11 on page 90.

8 Press the **RESTART** key to clear alarms and begin the test.

9 Verify that the green SIGNAL, FRAME, PATTERN, and PATH PTR LEDs are illuminated.

10 Verify that `Results OK` appears in the results display.

## STS-1 BER testing

The TestPad enables you to perform STS-1 BER tests with a DS3 or VT1.5 muxed payload.

**To perform an STS-1 BER test**

1 On the application button bar, select **TERM > Terminate STS-1** and the payload mapping.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select **OK** to return to the main screen.

4 Set the left result group to **SONET Pri** and the right result group to **T1 PRI** or **DS3 PRI**. Set both result categories to **Summary**.

5 Verify that the STS-1 PRIMARY RX and STS-1 PRIMARY TX yellow LEDs are illuminated.

6 Connect a cable from the STS-1 PRIMARY RX jack to the DSX OUT jack.

7 Connect a cable from the STS-1 PRIMARY TX jack to the DSX IN jack For a sample cabling diagram, see Figure 15 on page 94.

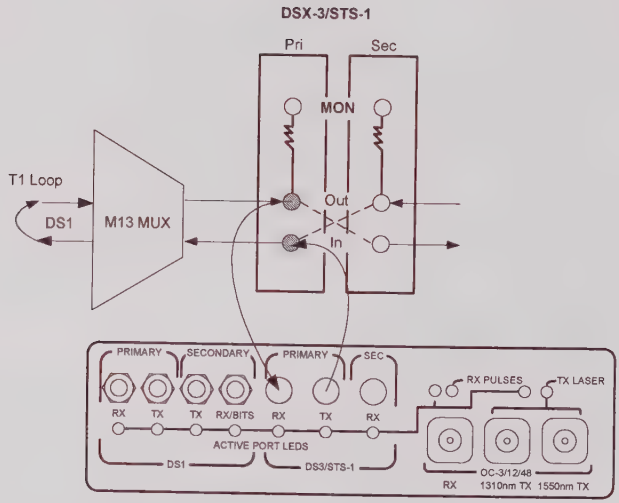



**Figure 20** STS-1 BER connection

8 Establish a far-end loop.

9 Press the **RESTART** key to clear alarms and begin the test.

10 Verify that the green SIGNAL, FRAME, and PATTERN LEDs for the chosen subrate, and SONET LEDs (and PATH PTR LEDs for SONET only) are illuminated.

11 Verify that `Results OK` appears in the results display.

## Monitoring VT1.5 signals

The following procedure outlines how to set up the TestPad to monitor VT1.5 or DS1 signals dropped from an STS-1 signal.

### To monitor VT1.5 signals

1 On the application button bar, select **MON/THRU > Monitor STS-1** (or **OC-3/OC-12/OC-48) > VT1.5 Drop > T1 BERT**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select **OK** to return to the main screen.

4 Set one result group **SONET Pri** and the other to **T1 Pri**. Set both result categories to **Summary**.

5 Verify that the DS3/STS-1 PRIMARY and SECONDARY RX yellow LEDs are illuminated.

6 Connect a cable from the DS3/STS-1 PRIMARY and SECONDARY RX jack to the Primary and/or Secondary side of the DSX-3/STX-1 MON jack For a sample cabling diagram, see Figure 11 on page 90.

7 Press the **RESTART** key to clear alarms and begin the test.

8 Verify that the green SIGNAL, FRAME, PATTERN, and PATH PTR LEDs are illuminated.

9 Verify that `Results OK` appears in the results display.

## Monitoring OC-3/OC-12/OC-48 performance

The OC-3/OC-12/OC-48 option enables you to transmit and receive SONET signals that contain either mapped STS-1 frames or concatenated payloads, such as OC-12 or OC-12c signals. The following procedure describes how to set up the TestPad to monitor and perform error/alarm insertion in Thru mode.

**To monitor OC-3/OC-12/OC-48 performance**

1 On the application button bar, select **MON/THRU > Monitor OC-3/OC-12/OC-48 > OC-3c/OC-12c/OC-48c BERT**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select **OK** to return to the main screen.

4 Verify that the OC-3/OC-12/OC-48 RX yellow LED is illuminated.

5 Connect a fiber cable from the OC-3/OC-12/OC-48 RX jack to the network's RECEIVE optical splitter access jack. For a sample cabling diagram, see Figure 12 on page 91.

**WARNING: HAZARDOUS LIGHT EXPOSURE**
Do not look directly into the optical output of the unit or at the output of any optical cable connected to the unit. If a fiber optic connection is removed from a transmitting connector, screw the safety cap onto the connector to prevent inadvertent exposure to the laser output.

6 Select the **RESTART** key to clear alarms and begin the test.

7 Verify that the green SONET SIGNAL, FRAME, and PATH PTR LEDs are illuminated.

8 Verify that `Results OK` appears in the results display.

9 Press the **RESTART** key to clear old results and begin a new test.

10 Verify that `Results OK` appears in the results display.

## OC-3/OC-12/OC-48 BER testing

The following procedure describes how to set up the TestPad to terminate a SONET signal for BER testing and perform error/alarm insertion on concatenated SONET signals.

**To perform an OC-3/OC-12/OC-48 BER test**

1 On the application button bar, select **TERM > Terminate OC-3/OC-12/OC-48 > OC-3c/OC-12c/OC-48c BERT**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select the **Error** tab, and then select **SONET Logic Error** as the error type.

4 Select **OK** to return to the main screen.

5 Set a result category to **Summary**.

6 Verify that the OC-3/OC-12/OC-48 RX and TX yellow LEDs are illuminated.

7 Connect a fiber cable from the OC-3/OC-12/OC-48 RX jack to the network's RECEIVE optical access jack.

8 Connect a fiber cable from the OC-3/OC-12/OC-48 TX jack to the network's TRANSMIT optical access jack. For a sample cabling diagram, see Figure 14 on page 93.

**CAUTION: INSTRUMENT DAMAGE**

Never loop the high-power TRANSMIT on OC-48 modules to the RECEIVE on the TestPad without adding optical attenuation. This will result in serious damage to the TestPad. An attenuated cable and attenuators are provided with the TestPad.

**WARNING: HAZARDOUS LIGHT EXPOSURE**

Do not look directly into the optical output of the unit or at the output of any optical cable connected to the unit. If a fiber optic connection is removed from a transmitting connector, screw the safety cap onto the connector to prevent inadvertent exposure to the laser output.

9 Select **Laser ON**.

10 Loop back the far-end of the network.

11 Select the **RESTART** key to clear alarms and begin the test.

12 Verify that the green PRI SONET SIGNAL, FRAME, PATTERN, and PATH PTR LEDs are illuminated.

13 Verify that `Results OK` appears in the results display.

14 Select the **SONET Logic Error** action button five times and verify that five logic errors are received.

15 Press **RESTART** to clear old test results and begin a new test.

## Measuring optical power

This test measures the optical power of a signal in an optical fiber.

**To measure optical power for OC-3/OC-12/OC-48**

1 On the application button bar, select **MON/THRU > Monitor OC-3/OC-12/OC-48 > OC-3c/OC-12c/OC-48c BERT**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select the **Wavelength** tab, and then select the optical power dBm (1310 nm or 1550 nm).

4 Set a result category to **Signal**.

5 Verify that the OC-3/OC-12/OC-48 RX yellow LED is illuminated.

6 Connect the fiber to be tested to the OC-3/OC-12/OC-48 RX jack. For a sample cabling diagram, see Figure 12 on page 91.

**WARNING: HAZARDOUS LIGHT EXPOSURE**

Do not look directly into the optical output of the unit or at the output of any optical cable connected to the unit. If a fiber optic connection is removed from a transmitting connector, screw the safety cap onto the connector to prevent inadvertent exposure to the laser output.

7 Press the **RESTART** key to clear alarms and begin the test.

8 Verify that the green PRI SONET SIGNAL LED is illuminated.

9 Read the optical power measured in the results display.

## Verifying APS switchover time

When automatic protection switching (APS) occurs, its conformance to the prescribed switchover time from "working line" to "protection line" is critical. The TestPad enables you to measure the APS switchover time of DS1, DS3, STS-1, OC-3, OC-12, and OC-48 signals when you monitor or terminate traffic. This allows you to verify that the end effect to the customer is a loss of customer traffic less than the ITU-T recommendation of 50 ms.

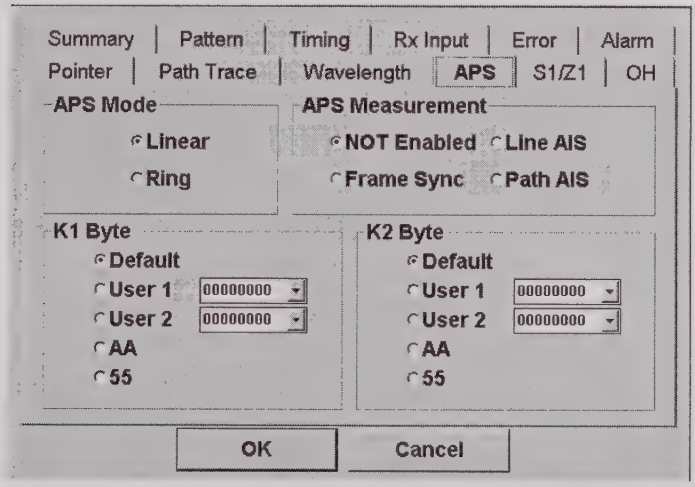
When you setup a test to verify APS switchover time, you must specify type of APS measurement to verify (frame synchronization, line AIS, or path AIS).

**To verify APS switchover time**

1 On the application button bar, select **Mon/Thru** or **Term**, and then select your application.

2 Select **Setup > Summary**. The Summary tab appears. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions for each tab.

3 Select the **APS** tab.




4 Under APS Measurement, select **Frame Sync**, **Line AIS**, or **Path AIS**.

5 Select **OK** to accept the test setup.

6 Connect a cable from the active transmit connector to the device under test (DUT) receive connector.

7 Connect a cable from the active receive connector to the DUT transmit connector.

8 Select the **APS Start** action button to start the test.

The status window displays:

```
APS waiting for "measurement type"
```

After the TestPad obtains frame sync, line AIS, or path AIS, the status window displays:

```
APS waiting for "measurement type"... OK
```

Where "measurement type" displays the type of APS measurement you selected in step 4.

9 Select the **Result Category** button, and then select the **Signal** result category to view signal results.

10 Using one of the following methods, initiate the APS switchover by forcing the network to switch to the protect lines:

| To | Method |
|---|---|
| Interrupt the signal | Physically interrupt the signal by pulling the signal from the add-drop multiplexer (ADM). |
| Insert errors | Use another TestPad in Thru mode to insert errors until the network switches to the backup lines. |

The TestPad measures frame, line, or path gain/loss. After the TestPad detects an APS condition, it automatically begins to measure the time in milliseconds until the condition returns to normal.

See "SONET Signal results" on page 214 for descriptions of SONET signal results.

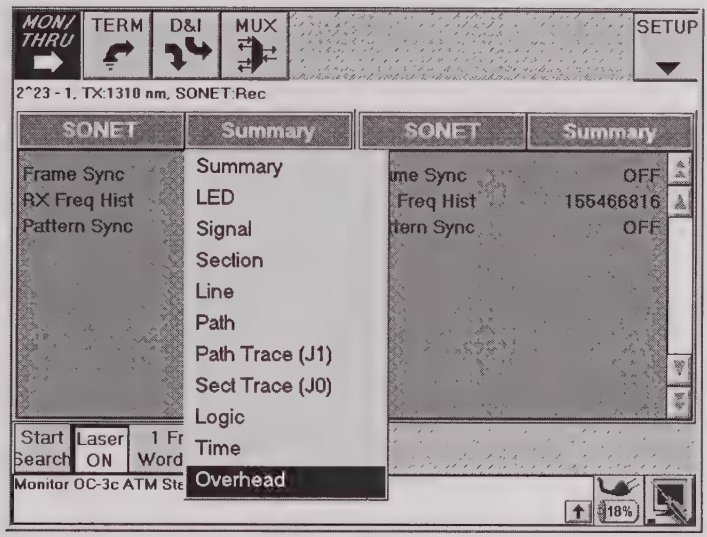
## Viewing overhead bytes

The TestPad enables you to display SONET overhead bytes in the Results panes.

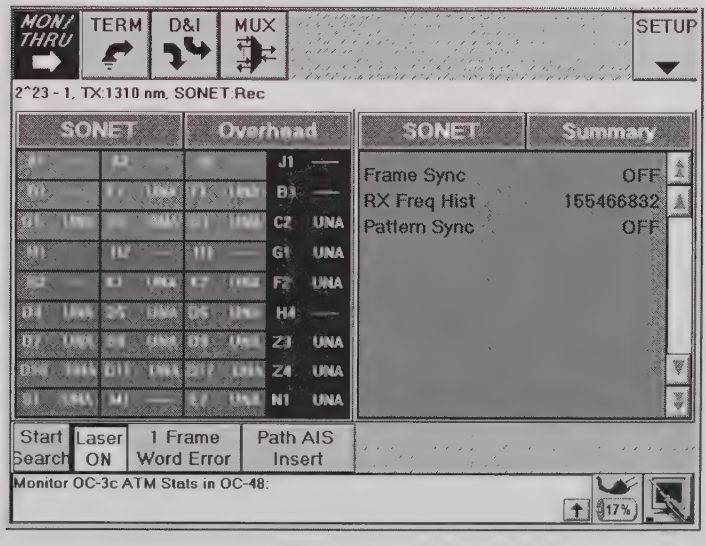
### To view overhead bytes

1 Use the application buttons to select your test application.

2 Select the **Result Category** button, and then select **Overhead**.




Overhead byte results appear in the results pane.



## Manipulating overhead bytes

The TestPad enables you to manipulate the value of selected overhead bytes. Most overhead bytes can be manipulated on the OH setup tab. Some overhead bytes (for example, the K1, K2, S1, and Z1 bytes) can be manipulated on additional setup tabs—manipulating the value for a byte on one tab automatically updates the value on the other setup tab.

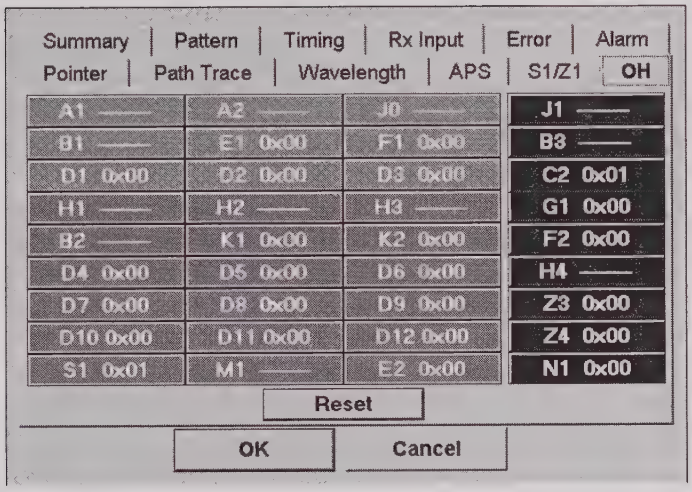
**NOTE:**

To manipulate the J1 (path trace) byte before you transmit an STS-1 signal, you must update the value on the Path Trace setup tab.

**To change the value of an overhead byte**

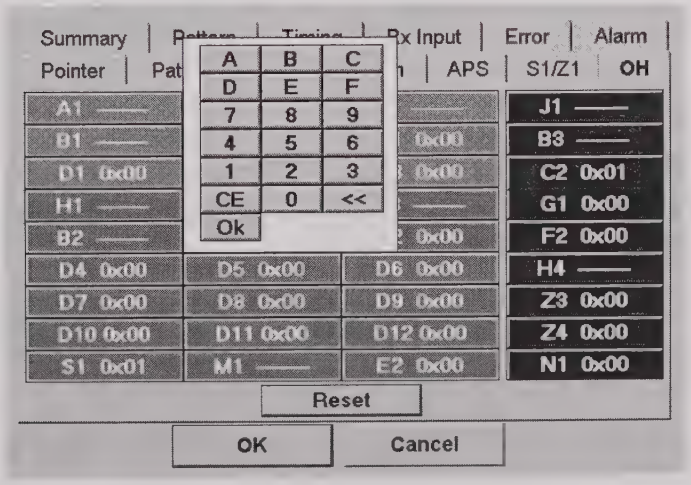
1. Use the application buttons to select your test application.
2. Select **Setup**.

   A menu appears listing Quick Configuration buttons.
3. To view the setup summary for the test, select **Summary**. The Summary tab appears. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions for each tab.
4. Select the **OH** tab to change the value of an overhead byte (or bytes).




**NOTE:**
You cannot change bytes marked with -------.

**a** Select the byte you want to update.
A keypad appears.




**b** Using the keypad, type the byte value, and then select **OK** to store the value and return to the OH tab.

c Select **OK** to return to the main screen.

Overhead byte results appear in the results panes.

## SONET drop and insert testing

The TestPad enables you to non-intrusively drop a lower rate signal within an in-service OC-48, OC-12, or OC-3 signal and replace it with a BERT pattern. For example, you can drop and insert a DS3 in an OC-48 signal.

**To perform a drop and insert test**

1 On the application button bar, select **D&1>D&I Signal>Rate**.

2 Select **Setup > Summary**. The Summary tab appears. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions for each tab.

3 Select the **Channel** tab, and then select channel to drop from the signal.

4 Select **OK** to return to the main screen.

5 Connect a cable from the OC-3/OC-12/OC-48 TX connector to the DUT receive connector.

6 Connect a cable from the OC-3/OC-12/OC-48 RX connector to the DUT transmit point. For a sample cabling diagram, see Figure 15 on page 94.

7 Select **Laser ON** to enable the laser.

8 Select the **Insert Primary** action button to insert the BERT pattern on the channel you specified in step 3.

9 Press **Restart** to clear results and begin the test.

10 Check for Signal, Frame, and Pattern Sync by verifying that the corresponding LEDs are green.

## About SDH testing

Synchronous digital hierarchy (SDH) is the international equivalent of SONET. Using the TB2310-SDH option, you can perform bulk payload tests on STM-1, STM-4c, and STM-16c signals from the optical interface. SDH testing verifies the quality of the circuit, identifies problems on the network that cause degraded performance, and verifies that the network is in accordance with ITU-T recommendations.

### SDH result categories

Many SDH and SONET standards are identical; therefore, the TestPad provides similar results for SONET and SDH test applications. When you interpret SDH results, refer to Table 8 through Table 11 to identify the SONET equivalent. See Chapter 11 "Test Results" on page 197 for a detailed description of each result category.

#### *Signal result categories*

The SDH and SONET signal result categories are identical.

#### *SDH RSOH result category*

The SDH RSOH result category provides similar results to the SONET section results category. Sonet frame results are referred to as "FAS" results, SONET Section BIP errors are referred to as "B1" errors, and SONET SEFs are referred to as "OOFs". Table 8 compares the RSOH and section result categories.

**Table 8** SDH RSOH and SONET section result categories

| SDH RSOH | SONET section equivalent |
|---|---|
| FAS Word Errors | Frame Word Errors |
| B1 Errors | Sect BIP Errors |
| B1 EQU Error Rate | Sect EQU BIP Error Rate |
| B1 Error Rate | Sect BIP Error Rate |
| B1 Error Secs | Sect BIP Error Secs |
| Section SES | Section SES |
| OOF | SEF Defect |
| OOF Secs | SEF Secs |

***MSOH result category***

The SDH MSOH result category provides similar results to the SONET line result category. SONET line results are referred to as "MS" results, SONET FEBE results are referred to as "REI" results, and SONET line BIP results are referred to as "B2" results. Table 9compares the MSOH and line result categories.

**Table 9** SDH MSOH and SONET line result categories

| SDH MSOH | SONET line equivalent |
|---|---|
| MS APS Msg Count | APS Msg Count |
| MS APS Protection Information | APS Request Msg |
| MS APS Protection Channel | APS Switch Mode |
| MS APS Bridged Line | APS Bridged Line |
| B2 Errors | Line BIP Errors |
| B2 EQU Error Rate | Line EQU BIP Error Rate |
| B2 Error Secs | Line BIP Error Secs |
| MS SES | Line SES |
| MS Unavail Secs | Line Unavail Secs |
| MS AIS secs | Line AIS Secs |
| MS REI | Line FEBEs |
| MS REI Rate | Line FEBE Rate |
| AU-4 Ptr Just | Path Ptr Just |
| AU-4 Ptr Inc | Path Ptr Inc |
| AU-4 Ptr Dec | Path Ptr Dec |
| AU-4 Ptr NDFs | Path Ptr NDFs |
| AU-4 Ptr Value | Path Ptr Value |
| AU-4 Ptr Size | Path Ptr Size |
| S1 Sync Message | S1 Sync Message |
| Z1 Byte | Z1 Byte |

***POH result category***

The SDH POH result category provides similar results to the SONET path result category. SONET path BIP results are referred to as "B3" results, SONET path results are referred to as "POH" results, SONET path AIS results are referred to as "AU-4" AIS results, and SONET FEBE results are referred to as "REI" results. Table 10 compares the POH and path result categories.

**Table 10** SDH POH and SONET path result categories

| SDH POH | SONET equivalent |
|---|---|
| B3 Errors | Path BIP Errors |
| B3 EQU Error Rate | Path EQU BIP Error Rate |
| B3 Error Secs | Path BIP Error Secs |
| POH SES | Path SES |
| POH Unavail Secs | Path Unavail Secs |
| AU-4 AIS secs | Path AIS secs |
| AU-4 AIS/LOP secs | Path AIS/LOP secs |
| AU-4 LOP | Path LOP secs |
| HP REIs | Path FEBEs |
| HP REI rate | Path FEBE rate |
| Signal label | Signal Label |

***Path trace result categories***

The SDH path trace result category provides similar results to the SONET trace result category. SONET path trace results are referred to as "J1" trace results, and SONET section trace results are referred to as "J0" trace results. Table 11 compares the trace result categories.

**Table 11** SDH and SONET trace result categories

| SDH trace | SONET equivalent |
|---|---|
| J1 Trace | Path Trace |
| J0 Trace | Section Trace |

***Logic result categories***

The SDH logic result categories are identical to the SONET logic result categories.

# ATM Testing

8

This chapter provides step-by-step instructions to configure and perform ATM tests. Topics discussed in this chapter include the following:


- "About ATM testing" on page 150
- "Searching for ATM cells" on page 158
- "Monitoring ATM payloads" on page 161
- "Terminating ATM payloads" on page 163

## About ATM testing

ATM is a technology that enables voice, video, and data traffic to be transmitted simultaneously over wide area networks at high speeds. Regardless of the type of traffic that enters an ATM network, the traffic is converted into fixed-length (53-byte) cells. The cells are then transported at high speeds through the network. When the cells reach their destination, they are converted back to their respective traffic types.

Benefits of ATM include:

- Uniform handling of voice, video, and data services
- A constant bit rate of circuit switching
- The high efficiency and bandwidth guarantee that packet-switching provides for data services

Transmission testing of ATM networks is critical because ATM service relies on high-quality transmission for optimal performance. The FST-2310 allows you to validate end-to-end connectivity, measure network throughput, and ensure quality of service metrics are satisfied for your ATM networks. The TestPad supports ATM analysis at DS1, DS3, OC-3c, and OC-12c rates with access from all rates and interfaces (DS1, DS3, STS-1, OC-3, OC-12, and OC-48).

The ATM options for the TestPad enable you to generate and analyze ATM payloads for each of the signal rates in Table 12:

**Table 12** ATM payloads

| Signal rate | ATM payload | Supports PCLP framing |
|---|---|---|
| DS1 | DS1 | Y |
| DS3 | DS3 | Y |
| | Multiplexed DS3 | Y |
| STS-1 | DS3 | Y |
| | Multiplexed DS3 | Y |
| | VT1.5 | Y |

**Table 12** ATM payloads (Continued)

| Signal rate | ATM payload | Supports PCLP framing |
|---|---|---|
| OC-3 | OC-3c | N |
| | DS3 | Y |
| | Multiplexed DS3 | Y |
| | VT1.5 | Y |
| OC-12 | OC-12c | N |
| | OC-3c | N |
| | DS3 | Y |
| | Multiplexed DS3 | Y |
| | VT1.5 | Y |
| OC-48 | OC-12c | N |
| | OC-3c | N |
| | DS3 | Y |
| | Multiplexed DS3 | Y |
| | VT1.5 | Y |

### In-service and out-of-service tests

Using the TestPad for out-of-service tests, you can generate ATM cells. For in-service testing, you can monitor ATM cell traffic to determine the type, location, and direction of alarms and errors. You can also test ATM signals to check HEC framing, generate TTC and O.191 ATM test cells, and record measurements on specific ATM streams. Test results allow you to correctly diagnose the network layer that is not functioning.

### Transmit and receive profiles

Before you perform ATM tests, you should define the most common transmit and receive profiles you expect to use. These profiles will be available each time you configure an ATM test.

After you define your profiles, you can select the profiles when you perform ATM tests. Selecting a profile enables you to:

- Analyze overall ATM measurements. Measurements may include header-error control (HEC) errors, dropped cells, cell types, and correlation tags, as well as bandwidth utilization.
- Generate ATM compliant idle cells. These cells fill unallocated payload bandwidth.
- Support network-node interface (NNI) and user-network interface (UNI) cell formats.

### *Defining transmit and receive profiles*

Five profiles are available. Four of the profiles can be defined as either transmit or receive profiles; the fifth must be defined as a receive profile.

When you define a transmit or receive profile, you specify settings that define the header characteristics of a cell stream. You identify the location of the cells by providing the virtual path identifier (VPI) and the virtual channel identifier (VCI). You can also define the generic flow control (GFC), payload type indicator (PTI), and cell loss priority (CLP) for the cells.

**To define a transmit or receive profile**

1 On the application button bar, select **MON/THRU/ TERM>signal>payload**. Table 12 on page 150 lists the available signals and payloads.

A menu appears listing the available tests.

2 Select a test, and then select **Setup > Summary**.

The Summary tab appears listing your default parameters.

3 Select the **ATM Profiles** tab.

4 Under Profile Settings, select the profile number (Profile 1, Profile 2, Profile 3, Profile 4, or Rx Profile), and then specify the GFC, VPI, VCI, PTI, and CLP for the profile.

**NOTE:**

You can enter X as the GFC, VPI, VCI, PTI, or CLP value for a receive profile to receive traffic regardless of the value of these fields.

Your transmit and receive profiles are now available each time you perform an ATM test.

### *Specifying transmit and receive profiles*

After you define transmit and receive profiles, you can specify the profiles when you configure an ATM test. Specifying transmit and receive profiles involves specifying a cell type, selecting the profile(s), and then specifying the bandwidth for the transmit profile.

You specify the type of cell you are analyzing on the ATM tab. Specifying a cell type enables the TestPad to transmit that type of cell (in Terminate mode), and enables the receiver to analyze the type of cell you specified.

**NOTE:**

The TestPad uses the cell type you specify for the primary transmit and the receive profile (if applicable).

The TestPad always transmits TTC ATM #0 test cells for the secondary profile.

Figure 21 shows the composition of the TTC ATM #0 test cell.

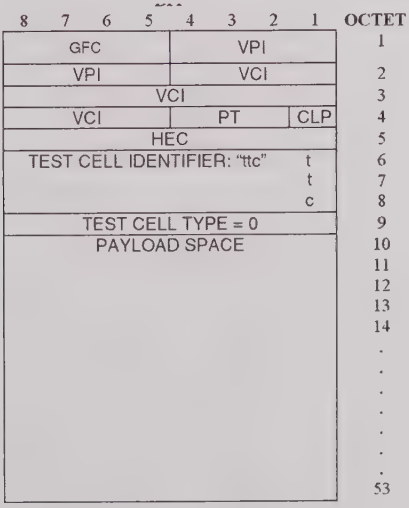



**Figure 21** TTC ATM test cell #0

After you specify the cell type, you select the profile(s) for your test on the ATM Profiles tab.

- If you are configuring an ATM test in Monitor mode, you select a single receive profile.
- If you are configuring an ATM test in Terminate mode, you select a primary transmit and a receive profile. You can also optionally specify a secondary transmit profile.

When you select the profile(s) for your test, you specify the network interface you are testing (UNI or NNI), and whether cell scrambling is on or off.

Finally, if you are performing an ATM test in Terminate mode, you specify the bandwidth for the primary and, if applicable, secondary transmit profile on the ATM Tx tab. When you specify the bandwidth for a transmit profile, you indicate whether the primary transmit profile cells are sent at a constant bit rate (CBR) or a variable bit rate (VBR).

- If the primary transmit profile cells are sent at a CBR, you specify the bandwidth for the primary and, if applicable, secondary transmit profile cells.
- If the primary transmit cells are sent at a VBR, you specify the constant bandwidth and peak bandwidth, and the burst gap and burst length for the primary transmit profile cells. If you specified a secondary transmit profile, you also specify the constant bandwidth for the secondary transmit profile.

Refer to "Constant and variable bit rate services" on page 156 for an explanation of constant and variable bit rate service.

**To specify transmit and receive profiles**

1 On the application button bar, select **MON/THRU/ TERM>signal>payload**. A menu appears listing the available tests.

2 Select a test, and then select **Setup > Summary**.

The Summary tab appears listing your default parameters.

3 Select the **ATM** tab.

4 Under Tx/Rx Cell Type, select the cell type for your test.

5 If you are testing DS1 or DS3 ATM cells, the default PLCP option is AUTO. When AUTO is selected, the TestPad can automatically detect whether PLCP is being received or not and configure both the transmitter and receiver as appropriate. To turn PLCP framing on, under PLCP, select **ON**. To turn PLCP framing off, select **OFF**.

6 Select the **ATM Profiles** tab.

7 If you are configuring an ATM test in monitor mode, under Rx Profile, select the receive profile for the test.

If you are configuring an ATM test in terminate mode, three profile selection groups appear under Tx/Rx Profile Selections:

| Under | Select |
|---|---|
| Pri Tx Profile | the primary transmit profile for the test |
| Rx Profile | the receive profile for the test |
| Sec Tx Profile | the secondary transmit profile for the test |

8 By default, scramble is ON. To turn scramble off, under Scramble, select **OFF**.

9 Under Interface, select the network interface (**UNI** or **NNI**).

10 Select the **ATM Tx** tab.

11 In Bandwidth Measured in, select **Percentage**, **Kbps**, or **Cells/Second**.

12 Under Primary Tx Profile Cells, select **Constant (CBR)** or **Variable (VBR)**.

13 If you selected Constant (CBR) in step 12, enter the bandwidth for the primary and, if applicable, secondary transmit profile cells in the corresponding Cont Bndwth fields.

If you selected Variable (VBR) in step 12, complete the following fields for the primary profile:

If applicable, enter the bandwidth for the secondary transmit profile in the corresponding **Cont Bndwth** field.

| In | Enter |
|---|---|
| Cont Bndwth | the contiguous bandwidth |

| In | Enter |
|---|---|
| Peak Bndwth | the peak bandwidth |
| Burst Gap | the burst gap permitted |
| Burst Length | the burst length permitted |

**14** The default correlation tag is 2310 (transmitted in hexadecimal notation). If you want to specify a different correlation tag, under Correlation Tag, select **User**. The User Tag field appears. Enter the correlation tag for the profiles in hexadecimal notation.

## Constant and variable bit rate services

Constant bit rate (CBR) service is typically used for applications in which end-to-end timing is critical, such as voice or video. Using the TestPad, you can specify a CBR for the primary and, if applicable, secondary transmit profiles you select for tests in terminate mode.

Variable bit rate (VBR) service is used primarily for applications in which end-to-end timing is not critical, such as data transmission. The TestPad also allows you to specify a VBR for a primary transmit profile.

Because ATM technology enables voice, video, and data traffic to be transmitted simultaneously over a link, a combination of constant bit rate and variable bit rate service is possible. Figure 22 illustrates how you can define a primary and secondary transmit profile to simulate a combination of constant and variable bit rate traffic with:

- CBR traffic on the primary profile at 40% capacity
- VBR traffic on the primary profile with bursts at 35% capacity
- CBR traffic on the secondary profile at 15% capacity

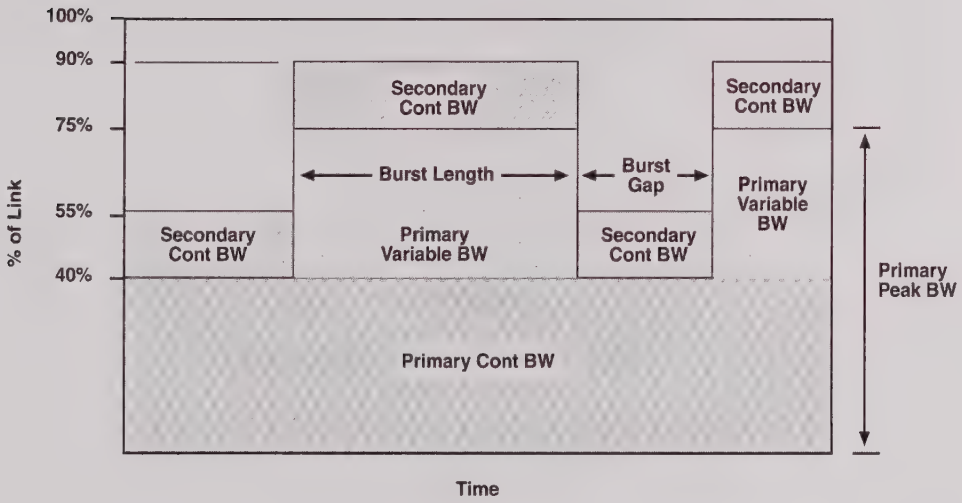



**Figure 22** Profile with CBR and VBR traffic

The sum of the CBR and VBR traffic on the primary profile is referred to as the *primary peak bandwidth*. In the example above, the primary peak bandwidth is 75%. The sum of the primary peak bandwidth and the secondary bandwidth is 90%. If the sum of the primary peak bandwidth and the secondary bandwidth exceeds 100%, the secondary bandwidth traffic is reduced accordingly whenever the TestPad transmits VBR traffic.

In Figure 22, the primary profile generates ATM traffic at a 40% continuous bandwidth with bursts of 35% at regular intervals.

When you configure a test to transmit VBR traffic, you specify the interval between transmissions of VBR traffic (referred to as the *burst gap*), and the duration to transmit the VBR traffic (referred to as the *burst length*). This tells the TestPad how often to transmit VBR traffic, and how long to transmit it.

When you transmit the traffic, the TestPad sends the type of cell you specified in the transmit profile as the CBR and VBR traffic for the primary bandwidth. The TestPad always sends TTC type 0 cells for the secondary bandwidth. The remaining bandwidth (if any) is filled with idle cells.

## Searching for ATM cells

When you view statistics in monitor/thru or terminate mode, you can search for specific ATM cell types in ATM payloads including the proprietary TTC 1 and TTC 4 cell types.

Figure 23 shows the composition of the TTC ATM test cell #1.

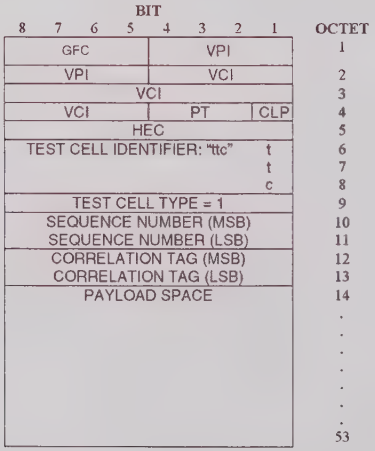



**Figure 23** TTC ATN test cell #1

Figure 24 shows the composition of the TTC ATM test cell #4.

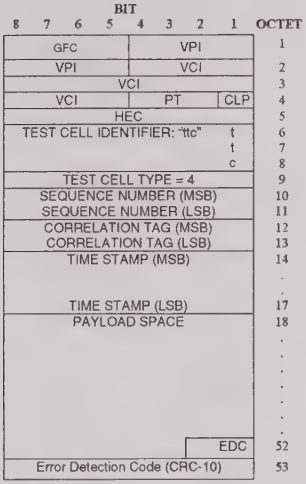



**Figure 24** TTC ATM test cell #4

**To search for ATM cells**

1 On the application button bar, select **MON/THRU/TERM > signal > payload > Stats** (see Table 12 on page 150 for available signals and payloads).

   You cannot search for ATM cells when you perform quality of service (QoS) tests.

2 After you select your test, the main screen displays the test and test configuration in the configuration summary bar. A Start Search action button appears.

   To specify search criteria, select **Setup**. A menu appears listing the Quick Configuration buttons.

3 Select **Summary** to display the Summary screen, and then select the **ATM** tab to specify the search criteria for the ATM cells.

4 Under ATM Search Type, select the type of ATM cell you want to locate. Available cell types are:

- Any TTC test cell
- Any test cell
- TTC #1
- TTC #4
- O.191
- Live traffic cells
- ATM AIS
- ATM RDI

5 If you are testing DS1 or DS3 ATM cells, the default PLCP option is AUTO. When AUTO is selected, the TestPad can detect whether or not PLCP is being received and configure both the transmitter and receiver as appropriate. To turn PLCP framing on, under PLCP, select **ON**. To turn PLCP framing off, select **OFF**.

6 Select **OK** to store the search criteria and return to the main screen.

**NOTE:**

PCLP framing is not applicable to OC-3c and OC-12c ATM rates.

7 Select **Start Search** to start the search process. The TestPad starts analyzing cells using the Rx profile selected for the test.

8 The second results pane provides buttons that allow you to navigate through the ATM cell stream. Select the **Next VPI/VCI** button to find the next VPI/VCI in the stream with cells meeting your search criteria.

These buttons are inactive while the TestPad is searching for a cell. After the TestPad locates a cell meeting your criteria, the buttons become active again.

**NOTE:**

If the search fails to find ATM cells meeting your criteria within 3 seconds, a message informs you that no cells were located.

The VPI/VCI address for the first cell meeting your criteria appears in the left results pane.

### Saving a VPI/VCI to the Receive Profile

When the TestPad displays the VPI/VCI address for the first cell meeting your search criteria, you can save the VPI/VCI address to the receive profile (Rx P). By saving the address to the receive profile, you can easily select the address the next time you monitor an ATM payload.

**To save a VPI/VCI address to the receive profile**

– Select the **Save VPI/VCI to Rx Profile** action button.

The TestPad saves the VPI/VCI address to the receive profile. To select this profile when you monitor an ATM payload, on the ATM Profiles tab, select **Rx P**.

## Monitoring ATM payloads

The following procedure describes how to monitor ATM payloads.

**To monitor an ATM payload**

1 On the application button bar, select **Mon/Thru> signal > payload > Stats** or **QoS** (see Table 12 on page 150 for available signals and payloads).

2 Select **Setup > Summary**. The Summary tab appears. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions for each tab.

3 Select the **ATM Profile** tab, and then specify the receive profile for your test (see "Specifying transmit and receive profiles" on page 153 for step-by-step instructions on specifying profiles).

4 Set both result groups to **ATM**. Set the left result category to **Summary**, and then set the right result category to **Stats**.

5 If you want to search for specific ATM cell types, select **Start Search** (see "Searching for ATM cells" on page 158 for step-by-step instructions on searching for ATM cells).

6 Verify that the RX yellow LED for your test is illuminated:

| Signals | LEDs |
|---|---|
| DS1, DS3, and STS-1 | PRIMARY RX yellow LED |

| Signals | LEDs |
|---|---|
| OC-3, OC-12, or OC-48 | OC-3/OC-12/OC-48 RX yellow LED |

7 Connect cables from the RX jack(s) for the signal rate you are testing to the RX jack(s) of the access point:

| Signal rate | Connect |
|---|---|
| DS1, DS3, STS-1 | – A cable from the PRIMARY RX jack to the primary test RECEIVE access point. For example, if you are monitoring an ATM payload on a DS1 signal, connect a cable from the DS1 PRIMARY RX jack to the DSX-1 A-Side MON jack. If you are monitoring an ATM payload on a DS3 or STS-1 signal, connect a cable from the DS3/STS-1 PRIMARY RX jack to the DSX-3 A-Side MON jack. |
| OC-3, OC-12, OC-48 | – A fiber cable from the OC-3/OC-12/OC-48 RX jack to the network's RECEIVE optical splitter access jack. |

For a sample cabling diagram for monitoring ATM signals on a DS1 payload, see Figure 11 on page 90. For a sample cabling diagram for monitoring ATM payloads on an optical signal, see Figure 12 on page 91.

**WARNING: HAZARDOUS LIGHT EXPOSURE**

Do not look directly into the optical output of the unit or at the output of any optical cable connected to the unit. If a fiber optic connection is removed from a transmitting connector, screw the safety cap onto the connector to prevent inadvertent exposure to the laser output.

8 Press the **RESTART** key to clear alarms and begin the test.

9 Verify that the Status LEDs are illuminated.

| Signals | LEDs |
|---|---|
| DS1 and DS3 | Green SIGNAL, FRAME, and ATM SYNC LEDs |
| STS-1, OC-3, OC-12, or OC-48 | Green SONET SIGNAL, FRAME, PATH PTR, and ATM SYNC LEDs |

10 Verify that `Results OK` appears in the test result pane, and then observe the ATM activity.

**NOTE:**

To view idle cell bandwidth on VPI/VCI = 0/0, the receive profile must be set to GFC=0, VPI=0, VCI=0, PTI=0, and CLP=1. The default CLP value is 0 and must be changed to recognize idle cells.

## Terminating ATM payloads

When you terminate an ATM payload, you analyze the payload by checking framing, generating ATM test cells, and recording measurements on specific ATM streams.

### Connectivity testing

The following procedure describes how to perform connectivity tests on ATM payloads.

**To perform a connectivity test**

1 On the application button bar, select **TERM>signal>payload >Stats** (see Table 12 on page 150 for available signals and payloads).

2 Select **Setup > Summary**. The Summary tab appears. Refer to Appendix C "Setup Descriptions" on page 291 for setup descriptions.

3 Specify the transmit and receive profiles for your test (see "Specifying transmit and receive profiles" on page 153 for step-by-step instructions on defining and selecting profiles).

4 Set both result groups to **ATM**. Set the left result category to **Summary**, and the right result category to **Stats**.

5 Verify that the RX and TX yellow LEDs for your test are illuminated.

| Signal | LEDs |
|---|---|
| DS1, DS3, STS-1 | PRIMARY TX and PRIMARY RX yellow LEDs |
| OC-3, OC-12, OC-48 | OC-3/OC-12/OC-48 RX and TX yellow LEDs |

6 Connect cables from the TX and RX jacks for the signal rate you are testing to the TX and RX jacks of the access point:

| Signal rate | Connect |
|---|---|
| DS1, DS3, STS-1 | – A cable from the DS1/DS3 PRIMARY TX jack to the appropriate side of the DSX-1/ DSX-3 TX (IN) jack (see Figure on page 165).<br>– A cable from the DS1/DS3 PRIMARY RX jack to the appropriate side of the DSX-1/ DSX-3 RX (OUT) jack. |
| OC-3, OC-12, OC-48 | – A fiber cable from the OC-3/OC-12/OC-48 RX jack to the network's RECEIVE optical access jack.<br>– A fiber cable from the OC-3/OC-12/OC-48 TX jack to the network's TRANSMIT optical access jack |

For a sample cabling diagram for terminating ATM signals on a DS1 payload, see Figure 13 on page 92. For a sample cabling diagram for terminating ATM payloads on an optical signal, see Figure 14 on page 93.

Figure  illustrates the proper connections for terminating ATM payloads on a DS1 signal.

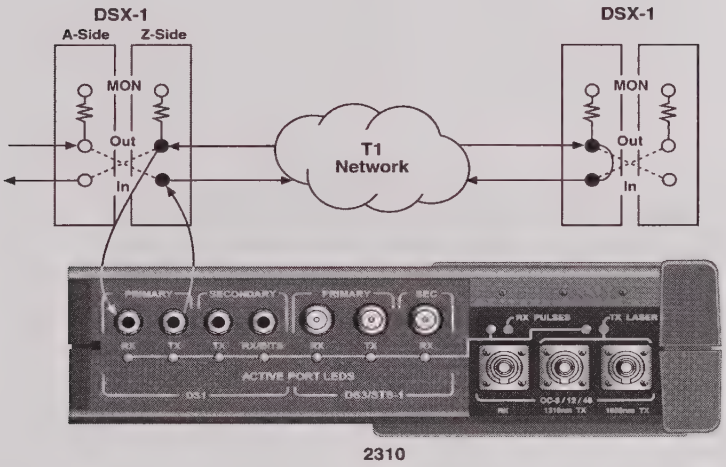



**Figure 25** DS1 termination test connections

Figure 26 illustrates the proper connections for terminating ATM payloads on an optical signal.

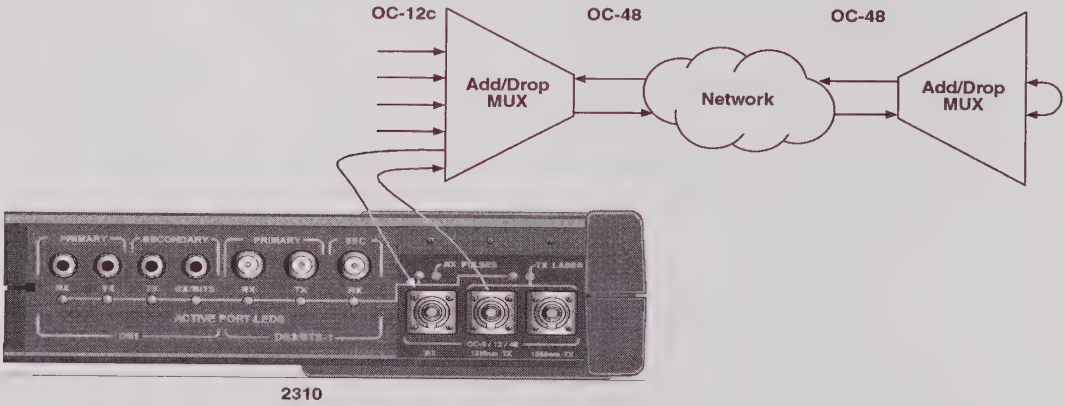



**Figure 26** OC-3/OC-12/OC-48 termination test connections

**WARNING: HAZARDOUS LIGHT EXPOSURE**

Do not look directly into the optical output of the unit or at the output of any optical cable connected to the unit. If a fiber optic connection is removed from a transmitting connector, screw the safety cap onto the connector to prevent inadvertent exposure to the laser output.

7 If you are performing the test on an OC-3, OC-12, or OC-48 signal, select **Laser On**.

8 Press the **RESTART** key to clear alarms and begin the test.

9 Verify that the Status LEDs are illuminated for your test.

| Signals | LEDs |
|---|---|
| DS1 and DS3 | Green SIGNAL, FRAME, and ATM SYNC LEDs |
| STS-1, OC-3, OC-12, or OC-48 | Green PRI SONET SIGNAL, FRAME, PATH PTR, and ATM SYNC LEDs |

10 Verify that `Results OK` appears in the test result pane. Observe the ATM activity.

## Measuring quality of service

The TestPad allows you to measure the quality of service for ATM payloads. Quality of service results include:

- the number of misinserted cells and the cell misinsertion rate (CMR)
- the number of out of sequence, lost, and errored cells
- the cell loss ratio (CLR)
- the cell error ratio (CER)
- the minimum, average, and maximum cell delay variation (CDV)
- the average and maximum round trip delay, and
- the severely errored cell block ratio (SECBR)

When you configure a quality of service test, you must specify the negotiated PCR (peak cell rate) for the payload (as stated in the customer's service level agreement).

The following procedure describes how to measure quality of service parameters.

**To measure quality of service**

1 On the application button bar, select **TERM > signal > payload > QoS.** Table 12 on page 150 lists the available signals and payloads.

2 Select **Setup > Summary**. The Summary tab appears. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions for each tab.

3 Select or define the transmit and receive profiles for your test (see "Transmit and receive profiles" on page 151 for step-by-step instructions on defining and selecting profiles).

**NOTE:**

You must select the same profile as your transmit and receive profile when you perform a quality of service test.

4 Select the **ATM** tab.

5 Under Tx/Rx Cell Type, select **0.191** or **TTC 4**.

6 In **Negotiated PCR (Cells/Sec)**, enter the peak cell rate based on the committed cell rate for the customer.

7 Set both result groups to **ATM**. Set both result categories to **QoS**.

8 Verify that the RX and TX yellow LEDs for your test are illuminated.

| Signals | LEDs |
|---|---|
| DS1, DS3, and STS-1 | PRIMARY TX and PRIMARY RX yellow LEDs |
| OC-3, OC-12, or OC-48 | OC-3/OC-12/OC-48 RX and TX yellow LEDs |

9 Connect cables from the TX and RX jacks for the signal rate you are testing to the TX and RX jacks of the access point.

**WARNING: HAZARDOUS LIGHT EXPOSURE**

Do not look directly into the optical output of the unit or at the output of any optical cable connected to the unit. If a fiber optic connection is removed from a transmitting connector, screw the safety cap onto the connector to prevent inadvertent exposure to the laser output.

10 Loop back the far end of the circuit under test.

11 If you are performing test on an OC-3, OC-12, or OC-48 signal, select **Laser On**.

12 Press the **RESTART** key to clear alarms and begin the test.

13 Verify that the Status LEDs are illuminated for your test.

| Signals | LEDs |
|---|---|
| DS1 and DS3 | Green SIGNAL, FRAME, and ATM SYNC LEDs |
| STS-1, OC-3, OC-12, or OC-48 | Green PRI SONET SIGNAL, FRAME, PATH PTR, and ATM SYNC LEDs |

14 Verify that `Results OK` appears in the test result pane and observe the QoS results.

## Inserting OAM and loopback cells

The TestPad allows you to transmit OAM cells to ensure that the network is recognizing alarm indication signal (AIS), and remote defect indication (RDI) cells. It also allows you to insert ATM loopback cells to verify path integrity.

When you configure a test to transmit OAM or loopback cells, you specify whether the cells are to be formatted for a virtual path connection (VPC) or virtual channel connection (VCC). You also indicate whether the cells should be transmitted to the next segment in the path, or end-to-end.

The following procedure describes how to insert OAM or loopback cells.

### To insert OAM or loopback cells

1. On the application button bar, select **TERM>signal>payload > Stats**. Table 12 on page 150 lists the available signals and payloads.
2. Select **Setup > Summary**. The Summary tab appears. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions for each tab.
3. Select the **OAM** tab.
4. Under OAM Type, select **Segment** to transmit the cells to the next network element in the path, or **End to End** to transmit the cells to the last network element in the path.
5. If you are transmitting loopback cells, under Loopback Type, select **VP Loop** to format the cells for a virtual path, or **VC Loop** to format the cells for a virtual channel.
6. If you are transmitting OAM cells, under Alarm Type, select the type of cells to transmit:

| To transmit | Select |
|---|---|
| AIS cells on a virtual path (F4) | VP AIS (F4) |
| AIS cells on a virtual channel (F5) | VC AIS (F5) |
| RDI cells on a virtual path (F4) | VP RDI (F4) |
| RDI cells on a virtual channel (F5) | VC RDI (F5) |

7 Select **OK** to return to the main screen.

8 If you are transmitting OAM cells, proceed to step 9.

If you are transmitting loopback cells, for each results pane, select the **Result Group** button, and then select **ATM**. For each results pane, select the **Result Category** button, and then select **Stats**.

9 Verify that the RX and TX yellow LEDs for your test are illuminated.

| Signals | LEDs |
|---|---|
| DS1, DS3, or STS-1 | PRIMARY TX and PRIMARY RX yellow LEDs |
| OC-3, OC-12, or OC-48 | OC-3/OC-12/OC-48 RX and TX yellow LEDs |

10 Connect cables from the TX and RX jacks for the signal rate you are testing to the TX and RX jacks of the access point.

11 If you are performing a test on an OC-3, OC-12, or OC-48 signal, select **Laser On**.

12 Press the **RESTART** key to clear alarms and begin the test.

13 To transmit an alarm cell, select the **Alarm** action button on the main screen.

To insert a loopback cell, select the **Insert Loopback** action button on the main screen.

The TestPad transmits the cell type (alarm or loopback) you specified when you configured your test. If you transmitted a loopback cell, you can view a count of the cells received and a count of timed out loopback cells in the results pane.

# GR-303 Testing

9

This chapter provides step-by-step instructions to monitor link statistics, monitor call statistics, and trace calls. Topics discussed in this chapter include the following:


– "About GR-303 testing" on page 172
– "Monitoring link statistics" on page 173
– "Monitoring call statistics" on page 176
– "Tracing calls" on page 178

# About GR-303 testing

GR-303 is a protocol that deploys transport voice and/or data traffic using GR-303 based digital loop carriers. GR-303 interfaces allow service providers to dynamically allocate time slots on DS0 signals to phone calls. Dynamic allocation provides increased efficiency and flexibility for circuit-switched services.

Proper testing of a GR-303 interface is essential to ensure that high-quality service is delivered while maintaining maximum efficiency. The FST-2310 enables you to test GR-303 based digital loop carriers as you install, provision, and support circuit-switched services. You can perform these tests from DS1, DS3, or STS-1 interfaces.

Using the TestPad, you can verify that traffic is being transmitted on time slot management channels (TMC)/common signaling channels (CSC) and embedded operations channels (EOC) when you turn up or provision a GR-303 protocol link. You can also view link statistics for a specific service access point identifier (SAPI) and/or terminal end point identifier (TEI), view call statistics that give you a high-level view of the TMC link activity, and isolate problems using any of several call filters.

Performing GR-303 tests involves:

- Determining that the service is functional at the physical layer
- Monitoring and analyzing Layer-2 link statistics
- Monitoring and analyzing Layer-3 call statistics
- Tracing calls to view detailed results and isolate the source of a problem

Before you monitor statistics or trace calls, you can specify filter parameters to select a specific subset of calls. When you monitor link statistics, you can select calls for a specific SAPI/TEI value. When you monitor call statistics, you can select calls that were disconnected or released for specific reasons by specifying a cause value as a filter parameter. When you trace calls, you can select calls by call type, DS1/DS0 assignment, origin, CRV, and cause value.

## Link statistics

When you monitor link statistics, the TestPad displays the current state of the link you are analyzing (as a result via virtual LEDs in the LED Category). The TestPad then categorizes the Layer-2 LAPD packets

as good packets, packets with CRC errors, or discarded packets according to their content and structure. Finally, the TestPad displays results such as the number of CRC errored packets, seconds where at least one CRC-errored packet is detected, and the rate at which CRC-errored packets occur.

### Call statistics

When you monitor Layer-3 call statistics, the TestPad counts all call attempts and call connects. It also counts all call disconnects and call releases due to the cause value you specify when you configure your test. For example, if you want to monitor statistics for all call disconnects resulting from a ring failure, you select the ring failure cause value (47) on the GR-303 tab. When you monitor the call statistics, the TestPad will count all call disconnects and call releases due to ring failures.

### Traced calls

After you verify that GR-303 service is functioning properly at the physical, data link, and network layers, you can use the TestPad to trace specific calls in the GR-303 link you are analyzing. Tracing calls allows you to view detailed TMC/CSC decode information for each call. The decode information helps you isolate the source of a problem for a call.

When you trace calls, the TestPad selects only calls that meet the filter criteria you specified when you configured the trace. For example, if you want to trace analog calls originating in a central office, you select the **Analog (POTS)** parameter as your call type, and then select the **Central Office** parameter as your origination source. Or, if you want to trace calls from a specific end-user, you can specify the call reference value (CRV) for up to nine calls as filter criteria.

## Monitoring link statistics

The TestPad allows you to count Layer-2 LAPD packets of the GR-303 TMC/CSC link to determine the accuracy of each packet.

When you configure your test, you specify a DS0 time slot within a framed T1 signal drop on the Channel tab. This DS0 is either the embedded-operations channel (EOC – typically channel 12) or the time-management channel/common-signaling channel (TMC/CSC – typically channel 24).

You can specify filter parameters on the GR-303 tab to choose packets with a specific SAPI/TEI value. If you do not specify a SAPI and/or TEI value as filter parameters, the TestPad will display link statistics for any SAPI/TEI value. You can also filter based on cause values (Layer-3).

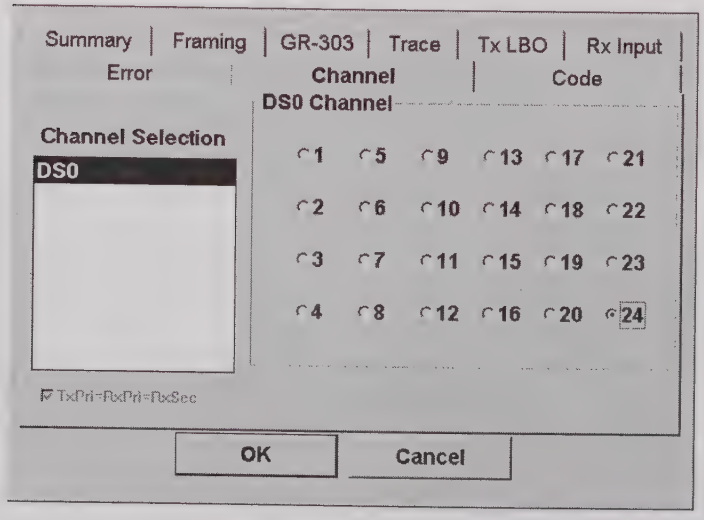
**To monitor link statistics**

1 On the application button bar, select **MON/THRU > Monitor T1** or **Monitor DS3 > GR-303**.

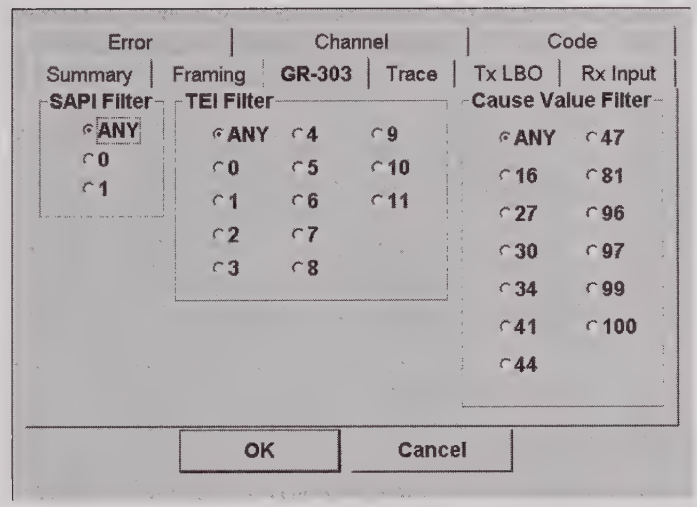
2 Select **Setup > Summary**. The Summary tab appears. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions for each tab.

3 Select the **Channel** tab, and then select the DS0 channel for the link you are monitoring: EOC (typically Channel 12) or TMC/CSC (typically Channel 24).

If you are monitoring statistics from a DS3 or STS-1 access point, select the DS1 channel for the GR-303 link you are monitoring.




4 To filter your statistics, select the **GR-303** tab.




5 Under SAPI Filter, select the SAPI for the calls you are analyzing. For TMC or CSC channels, either 0 or 1 is a valid SAPI value. For EOC channels, 1 is the only valid SAPI value.

6 Under TEI Filter, select the TEI for the calls you are analyzing. Select **OK** to return to the main screen. For TMC or CSC channels, 0 is the only valid value. For EOC channels, 0 through 11 are valid.

**NOTE:**

If you do not specify filter parameters, the TestPad will monitor calls for any SAPI or TEI.

7 Set each result group to **T1 PRI** or **T1 SEC**. Set the left result category to **Link Stats**, and the right result category to the link statistics you want to view.

**NOTE:**

You can select either T1 PRI or T1 SEC when you monitor link statistics because link statistics reflect information traced on either the PRI or SEC receiver.

8 Verify that the PRIMARY and SECONDARY RX yellow LEDs are illuminated.

9 Connect a cable from the PRIMARY RX jack to the DSX-1 or DSX-3 A-Side MON jack.

**10** Connect a cable from the SECONDARY RX jack to the DSX-1 Z-Side MON jack (see Figure 27).

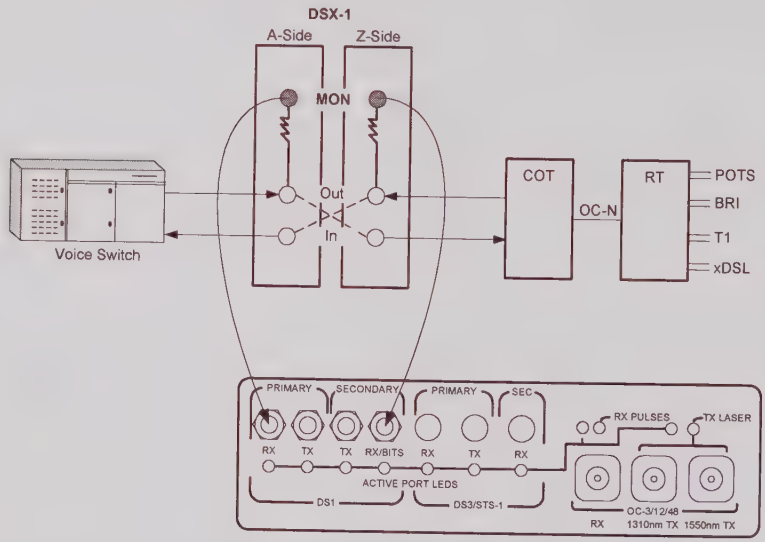



**Figure 27** GR-303 test setup

**11** Press the **RESTART** key to clear alarms and begin the test.

**12** Verify that the green SIGNAL and FRAME LEDs are illuminated.

Link statistics appear in the results panes.

## Monitoring call statistics

The TestPad allows you to examine the Layer-3 data of the GR-303 TMC/CSC link to examine call processing messages and to accumulate statistics associated with call processing.

When you monitor call statistics, the TestPad counts all call attempts and call connects. The TestPad also displays results for all call disconnects and call releases that occur due to the cause value you specify as filter criteria when you configure your test. Finally, the TestPad indi-

cates the percentage of calls that were not connected because a free timeslot in the GR-303 system was not available. These calls are identified as "Blocked Calls."

**NOTE:**

To monitor call statistics from DS3 or STS, the TestPad must have the Dual DS3/STS1 Receiver option.

**To monitor call statistics**

1 Follow Steps 1 through 7 of "Monitoring link statistics" on page 173.

2 On the GR-303 tab, under Cause Value Filter, select the cause value for the call disconnects and call releases you are analyzing.

The following cause values are available:

| Code | Cause Value |
|---|---|
| ANY | Unspecified cause value |
| 16 | Normal clearing |
| 27 | Destination out of service |
| 30 | Response to STATUS ENQUIRY |
| 34 | Channel unavailable |
| 41 | Temporary failure |
| 44 | Line unit unavailable |
| 47 | Ring failure |
| 81 | Invalid call reference |
| 96 | Mandatory information element missing |
| 97 | Message unimplemented |
| 99 | Information element unimplemented |
| 100 | Invalid information element contents |

3 Select **OK** to return to the main screen.

**NOTE:**

If you do not specify filter parameters, the TestPad will monitor calls for any SAPI/TEI or cause value.

4 Set both result groups to **T1 PRI**. Set the left result category to **Call Stats** and the right result category to the category for the call statistics you want to view.

**NOTE:**

You must select the T1 PRI result group to monitor call statistics because call statistics reflect call information bidirectionally (over the entire link).

5 Verify that the PRIMARY and SECONDARY RX yellow LEDs are illuminated.

6 Connect a cable from the PRIMARY RX jack to the DSX-1 or DSX-3 A-Side MON jack.

7 Connect a cable from the SECONDARY RX jack to the DSX-1 or DSX-3 Z-Side MON jack (see Figure 27 on page 176).

8 Press the **RESTART** key to clear alarms and begin the test.

9 Verify that the green SIGNAL and FRAME LEDs are illuminated.

Call statistics appear in the results panes.

## Tracing calls

After you monitor link and call statistics to verify that GR-303 service is operating properly at the data link and network layers, you can use the TestPad to trace specific calls. Tracing calls allows you to view detailed decode information for each call, which helps you isolate the source of a problem.

When you trace calls, you can filter the calls by call type, DS1/DS0 call assignment, origination source, and CRV. You also specify a cause value as filter criteria to trace calls that were disconnected or released for a specific reason.

You can optionally specify a duration after which the TestPad will automatically stop tracing each call. For example, to tell the TestPad to stop tracing each call after 30 seconds, you can select the 30 Seconds parameter from the Remove Traced Call After field on the Trace screen. If you want to trace calls for an indefinite period of time, you select the Indefinite parameter.

When you start tracing the calls, the TestPad automatically detects the call processing method on a link (TMC or CSC), allowing it to display trace results specific to the method.

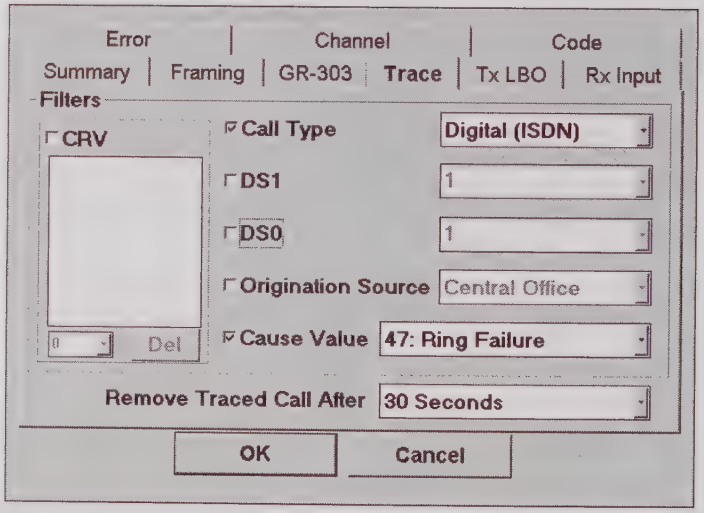
**To trace GR-303 calls**

1 Follow Steps 1 through 7 of "Monitoring link statistics" on page 1734.

2 On the GR-303 tab, under Cause Value Filter, select the cause value for the call disconnects and call releases you are tracing. The following cause values are available:

| Code | Cause Value |
|---|---|
| 16 | Normal clearing |
| 27 | Destination out of service |
| 30 | Response to STATUS ENQUIRY |
| 34 | Channel unavailable |
| 41 | Temporary failure |
| 44 | Line unit unavailable |
| 47 | Ring failure |
| 81 | Invalid call reference |
| 96 | Mandatory information element missing |
| 97 | Message unimplemented |
| 99 | Information element unimplemented |
| 100 | Invalid information element contents |

3 Select the **Trace** tab.




4 Specify the filter parameters for the calls you want to trace.

| To trace | Select |
|---|---|
| A call (or calls) from a specific location | **CRV**, and then select the arrow to the right of the field to enter the CRV for the first call you want to trace. Select **OK** to store and display the CRV in the list box above the field. You can enter up to nine CRVs for the trace.<br>To delete a CRV from the list box, select the CRV, and then select **Del**. |
| Digital or analog calls | **Call Type**, and then select the arrow to the right of the field to select **Digital (ISDN)** or **Analog (POTS)**. |
| Calls for a specific DS1 | **DS1**, and then select the arrow to the right of the field to enter the DS1 assignment for the calls. Valid values for this field are 1 through 28. |
| Calls for a specific DS0 | **DS0**, and then select the arrow to the right of the field to enter the DS0 assignment for the calls. Valid values for this field are 1 through 24. |

| To trace | Select |
|---|---|
| Calls originating from the central office or a remote terminal | **Origination Source**, and then select the arrow to the right of the field to select **Central Office** or **Remote Terminal**. |

5 To filter traced calls for a specific cause value, select **Cause Value**, and then select the arrow to the right of the field to select one of the following cause values:

| Code | Cause Value |
|---|---|
| 16 | Normal clearing |
| 27 | Destination out of service |
| 30 | Response to STATUS ENQUIRY |
| 34 | Channel unavailable |
| 41 | Temporary failure |
| 44 | Line unit unavailable |
| 47 | Ring failure |
| 81 | Invalid call reference |
| 96 | Mandatory information element missing |
| 97 | Message unimplemented |
| 99 | Information element unimplemented |
| 100 | Invalid information element contents |
| | Non-normal clearing |

6 In **Remove Traced Call After**, select a duration after which the TestPad will automatically stop tracing each call. If you want to trace calls for an indefinite period of time, select **Indefinite**.

7 Select **OK** to return to the main screen.

8 Set the left result group to **T1 PRI**. Set the result category to **Trace**. Nine results panes appear.

**NOTE:**

You must select T1 PRI to trace calls.

**9** Verify that the PRIMARY and SECONDARY RX yellow LEDs are illuminated.

**10** Connect a cable from the PRIMARY RX jack to the DSX-1 or DSX-3 A-Side MON jack.

**11** Connect a cable from the SECONDARY RX jack to the DSX-1 or DSX-3 Z-Side MON jack (see Figure 27 on page 176).

**12** Press the **RESTART** key to clear alarms and begin the test.

**13** Verify that the green SIGNAL and FRAME LEDs are illuminated.

**14** Select **Start Tracing**.

The first nine calls meeting your filter criteria appear in the nine Results panes.

## Viewing decode information

**To view decode information for a traced call**

– Select **View Trace**, and then select one of the nine calls displayed in the Results panes. The Call Trace Decodes window appears, listing the detailed decode information for the call. To return to the main screen, select **Close Decode Window**.

## Printing a traced call

**To print a traced call (or calls)**

– Select the **Print Trace** action button, and then select the Results panes for each call you want to print.

## Clearing a trace

**To clear traced calls**

– Select the **Clear Trace** action button, and then select the Results pane for each call you want to clear. Each time you clear a traced call (or a traced call times out on its own), the TestPad displays the next available call meeting your trace criteria. A Clear Trace action button is also available on the Call Trace Decodes window.

**NOTE:**

You can stop tracing all calls by selecting the Stop Tracing button.

# ISDN Testing

10

This chapter provides step-by-step instructions to perform ISDN tests. Topics discussed in this chapter include the following:


- "About ISDN testing" on page 186
- "Monitoring ISDN PRI calls" on page 186
- "Placing and receiving calls" on page 188
- "Testing NFAS and backup D channel" on page 193

## About ISDN testing

Using the ISDN Primary Rate option on the FST-2310, you can test the operational status of ISDN PRI links that use T1, DS3, and STS-1 as the physical interface. Features of this option include the following:

- Supports LUCENT 5ESS, NORTEL DMS 100, and National ISDN-2 Call Control specifications.
- Supports different call types such as 3.1K, 56K, 64K, Nx64K, Nx56K, H0, and H11.
- Places or receives two simultaneous voice or data calls while emulating a Terminal Equipment (TE) device (for example, PBX).
- Allows you to dial a 21-digit number when you place a call, and enter DTMF tones (after the call is connected) if you are dialing into a private branch exchange (PBX) to connect from the PBX to an extension.
- Allows you to view a caller's name using caller ID and block your number from displaying on caller ID.
- Provides test data services with BERT patterns or test voice services with a microphone and speaker.
- Provides history of calls that were placed and terminated, as well as providing their corresponding cause codes.
- Monitors physical layer (T1, DS3, and STS-1), and provides decodes of LAPD and Q.931 messages signaling on the D channel when in Monitor mode.
- Performs back-up D channel testing and provides the ability to support Non-Facility-Associated Signaling (NFAS).

## Monitoring ISDN PRI calls

In Monitor mode, the TestPad allows full duplex, non-intrusive monitoring of a single D channel, which enables interpreting messages from Terminal Equipment (TE) to Network Termination (NT), as well as messages from NT to TE. In addition to providing the T1, DS3, and STS-1 results, the TestPad provides full text decodes of the messages on the D channel.

**To monitor ISDN PRI calls**

1 On the menu bar, select **MON/Thru** and select the rate. Select **ISDN PRI**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select **OK** to return to the main screen.

4 Set a result category to **Decodes**.

5 Verify that the PRIMARY and SECONDARY RX yellow LEDs are illuminated.

6 Connect a cable from the PRIMARY RX jack to the DSX-1 A-Side MON jack.

7 Connect a cable from the SECONDARY RX jack to the DSX-1 Z-Side MON jack (see Figure 28).

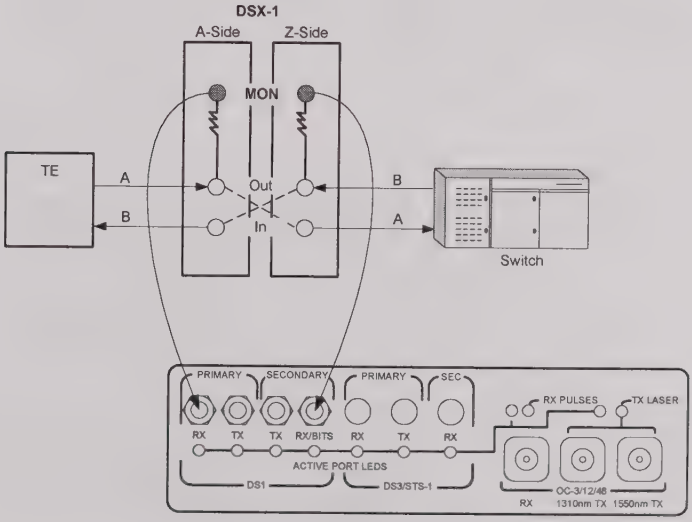



**Figure 28** Monitor ISDN PRI test setup

8 Press the **RESTART** key to clear alarms and begin the test.

9 Select **Start Capture**.

**10** View the D channel message decodes.

The number of frames captured and the percent of buffer used displays in the status message window.

**11** Select **Stop Capture** to display the last captured frame in the display window. To scroll through the list of captured frames, select any of the four action buttons.

If no frames are captured, `no frames captured` appears.

**12** Observe results in the results display.

**13** Verify that the green SIGNAL and FRAME LEDs are illuminated.

**14** Verify that `Results OK` appears in the results display.

## Placing and receiving calls

The Terminate ISDN PRI test application emulates a TE device, such as a PBX. Place Call and Receive Call is an advanced supported feature of Terminate Mode PRI. It enables the processing of up to two simultaneous calls (two terminating, two placing, or generating one call while terminating a second call). One or two calls may be placed on the same T1 or on different T1s (in NFAS mode).

### Placing a call

This test allows you to place calls to and from the network. To place calls, you must configure your test application for the correct switch type and D channel. After you configure the application, the TestPad establishes the data link and is ready to carry out ISDN call processing. The TestPad enables BERT and VF analysis of the B channels in use after a call is established.

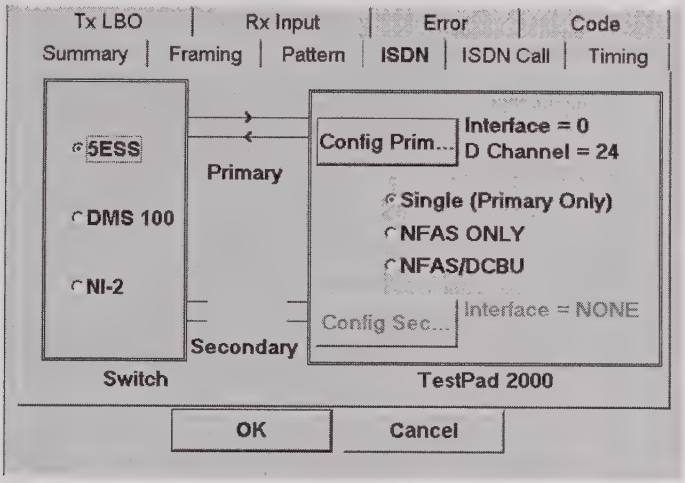
In addition to providing results for the physical interface, the TestPad also provides statistics collected on the D channel and results based on the analysis of the B channel. The Call Controls supported in this mode include Lucent 5ESS, NT DMS 100, and NI-2.

#### To place a call

**1** On the application button bar, select **TERM>Rate>ISDN PRI**.

2 Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select the **ISDN** tab.



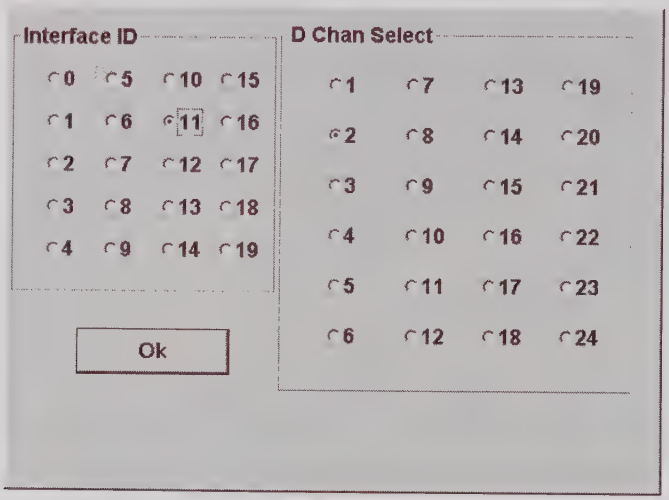

4 On the left side of the tab, select the switch type (**5ESS**, **DMS 110**, or **NI-2**).

**NOTE:**

The DMS and 5ESS selections are for switches running vendors-proprietary ISDN. For switches running National ISDN, select NI-2 (regardless of the switch manufacturer).

5 Select **Config Prim**.

A screen appears which allows you to select the interface ID and D channel.

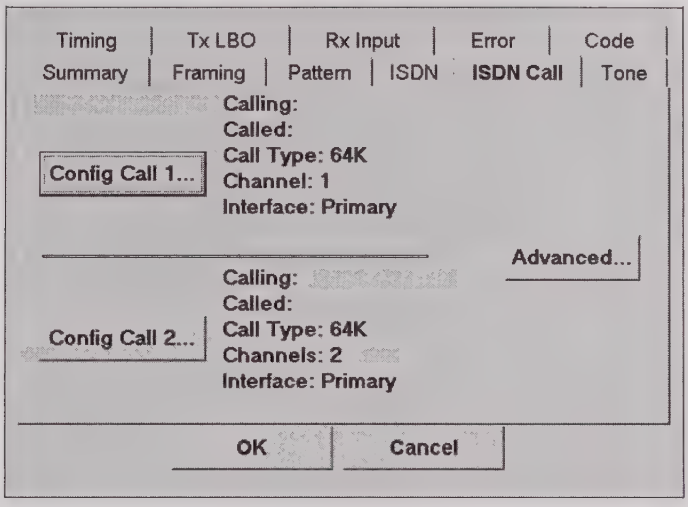



6 Select the interface ID and D channel, and then select **OK** to return to the ISDN tab.

7 Under the Config Prim option, select a D channel test type (**Single**, **NFAS ONLY**, or **NFAS/DCBU**).
   - If you select **NFAS ONLY** or **NFAS/DCBU**, proceed to step 8.
   - If you select **Single**, proceed to step 9.

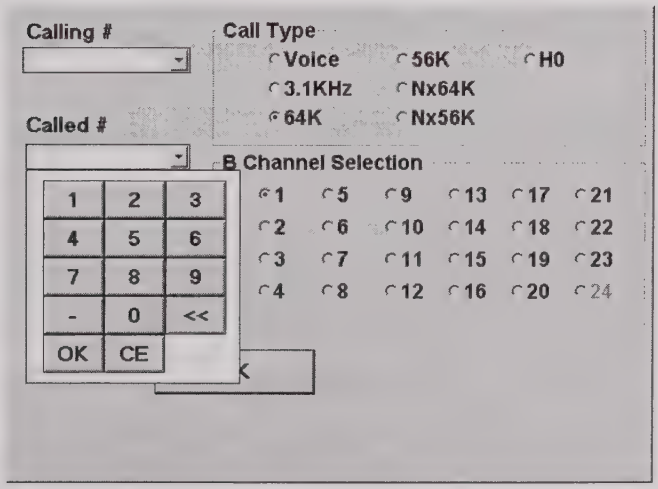
8 Select **Config Sec** to configure the secondary switch.
   - If you selected **NFAS ONLY** in step 7, select the interface ID.
   - If you selected **NFAS/DCBU**, select the interface ID and D channel. Select **OK** to return to the ISDN tab.

**9** Select the **ISDN Call** tab.




**10** Select **Config Call 1** to configure the call.

The ISDN Call Type screen appears.




**11** Select the arrow to the right of the **Calling #** field to display a keypad. Use the keypad to type the number of the ISDN line being tested.

If you want to enter the number to dial out, select the arrow to the right of the **Called #** field to display a keypad, and then type the number.

**12** Select the call type and the B channels.

**13** Select **OK** to return to the ISDN Call tab.

**14** If you want to configure a second call, select **Config Call 2** and repeat steps 12 - 14.

**15** Verify that the PRIMARY RX and TX yellow LEDs are illuminated.

**16** Connect a cable from the PRIMARY RX jack to the DSX-1 A-Side OUT jack.

**17** Connect a cable from the PRIMARY TX jack to the DSX-1 Z-Side IN jack.

**18** Press the **RESTART** key to clear alarms and begin the test.

**19** Verify that the green SIGNAL and FRAME LEDs are illuminated.

**20** Verify that `Results OK` appears in the results display.

**21** Select a **Result Category** button and select **LED**. Observe the D CHAN READY LED to verify that the D channel and/or the backup D channel are in service.

**22** Select **Enter PRI Call Control**. Select **Conn** to initiate the call.

The call status is displayed in the Configuration Summary bar.

## Connecting to an extension

After a call is connected, if you are dialing into a private branch exchange (PBX) you can dial an extension to connect from the PBX to the extension. To dial an extension, you must configure the call as an outgoing voice call on Call 1.

### To connect from the PBX to an extension

**1** Select **Enter Dial** to display a keypad.

The Enter Dial button label becomes Exit Dial.

**2** Use the keypad to dial one or more extensions.

**3** Select **Exit Dial** to return to the main screen.

### Receiving a call

When an ISDN call from the network is received by the TestPad, a flashing **Enter PRI Call Control** action button appears, and a message appears in the status display.

**To receive a call**

1. Select **Enter PRI Call Control** to open the PRI CALL CONTROL keypad.
2. Select **Answer** (or **Reject**) for the incoming call.
3. Select **Push 2 Talk** and speak into the microphone to establish a voice path.
4. Select **Disc** to disconnect the call.
5. Connect a cable from the PRIMARY RX jack to the DSX-1 A-Side (OUT) jack.
6. Connect a cable from the PRIMARY TX jack to the DSX-1 Z-Side (IN) jack.
7. Press the **RESTART** key to clear alarms and begin the test.
8. Verify that the green SIGNAL and FRAME LEDs are illuminated.
9. Verify that `Results OK` appears in the results display.

## Testing NFAS and backup D channel

The backup D channel option enables all signaling information to take place on one D channel for both PRI interfaces on the Network Facility Associated Signaling (NFAS). There is also a dedicated channel on the non-active D channel interface which carries signaling information in case the primary D channel fails.

**To test a NFAS and backup D channel**

1. On the application button bar, select **TERM** and select the rate. Select **ISDN PRI**.
2. Select **Setup > Summary** to verify that the setup summary matches the network configuration. To change a setting, select the appropriate setup tab. Refer to Appendix C "Setup Descriptions" on page 291 for field descriptions.

3 Select the **ISDN** tab, and then choose the switch type.

4 Select **Config Prim**, and then select the interface and D channels. Select **NFAS** or **NFAS/DCBU**, depending on the PRI line characteristics.

5 Set the secondary Interface ID to **1**. If you selected NFAS/DCBU, select **24** for the D Chan Select.

**NOTE:**

The Interface ID is most commonly set to 1 for the backup D channel. However, if a non-standard ID is assigned, it must match the switch.

6 Select **OK** to return to the main screen.

7 The left display window is automatically set to display LED results. Select the **Result Category** button in the right display window and select **ISDN Stats**.

8 To initiate the D channel to test the switch over of a standby D channel to the in-service D channel, disconnect the in-service T1 or select **Switch D-Chan**.

9 Continue by placing and receiving calls (see "Placing a call" on page 188 and "Receiving a call" on page 193).

10 Switch between D channels when testing NFAS/DCBU. Do this several times by selecting **Switch D-Chan**.

Table 13 describes the D channel messages that may appear in the Message Display.

**Table 13** D channel states and descriptions

| D channel States | Description |
|---|---|
| In Service | D channel carries signaling information. |
| Out of Service | D channel is not available. |
| Maintenance Busy | State is entered automatically when state changes are taking place on the other interface. |
| Wait | D channel is waiting for a response from the network in order to enter the in-service state. |
| Standby | D channel is transitioning to the in-service state in the case of the primary D channel failure. |

# Test Results

11

This chapter describes test results for the TestPad. The topics discussed in this chapter include the following:


- "About test results" on page 199
- "Result categories" on page 199
- "Summary results" on page 200
- "LED results" on page 202
- "Signal results" on page 212
- "Time results" on page 218
- "BPV results" on page 218
- "Frame results" on page 219
- "T1 BERT results" on page 223
- "DS3 Parity results" on page 226
- "SONET results" on page 227
- "Analyzing SONET and SDH overhead bytes" on page 237
- "SDH results" on page 238
- "Channel results" on page 248
- "Call Signal results" on page 251
- "Traffic results" on page 251
- "Logic results" on page 252

– "ATM results" on page 254
– "GR-303 results" on page 258
– "PRI ISDN results" on page 262

## About test results

After you connect the TestPad, results for the configured test automatically accumulate. Select a category in each display pane to analyze the results for your test. To view the appropriate result category, see "Step 4: Viewing test results" on page 96.

## Result categories

Table 14 lists the available result categories for each rate or payload.

**Table 14** Result categories

| Category | DS1 | DS3 | SONET | SDH | PRI ISDN | ATM | GR-303 |
|---|---|---|---|---|---|---|---|
| LED | x | x | x | x | x | x | x |
| Summary | x | x | x | x | x | x | x |
| Signal | x | x | x | x | x | x | x |
| Time | x | x | x | x | x | x | x |
| BPV | x | x | | | x | x | x |
| Frame | x | x | | | x | x | x |
| Traffic | x | x | | | x | x | x |
| Bridgtap | x | | | | | | |
| Multipat | x | | | | | | |
| Channel (VF and DDS T1 applications only) | x | x | x | | | | |
| Logic | x | x | x | x | | | |
| Parity | | x | | | | | |
| Section | | | x | | | | |
| Line | | | x | | | | |
| Path | | | x | | | | |
| VT | | | x | | | | |

**Table 14** Result categories (Continued)

| Category | DS1 | DS3 | SONET | SDH | PRI ISDN | ATM | GR-303 |
|---|---|---|---|---|---|---|---|
| Overhead | | | x | x | | | |
| RSOH | | | | x | | | |
| MSOH | | | | x | | | |
| POH | | | | x | | | |
| Path Trace | | | x | x | | | |
| QoS | | | | | | x | |
| Cell Type | | | | | | x | |
| Stats | | | | | | x | |
| Errors | | | | | | x | |
| History | | | | | x | | |
| ISDN Stats | | | | | x | | |
| Decodes | | | | | x | | x |
| Link Stats | | | | | | | x |
| Call Stats | | | | | | | x |
| Trace | | | | | | | x |

Many of the categories are discussed with their test results.

## Summary results

The Summary category automatically displays error results that are non-zero, key results that are out-of-specification, or key informational results.This allows quick access to the results without having to search each category.

If an errored or out of specification result appears, the pane has a red background. If only informational results appear, the pane has a white background. If all Summary results are within the recommended spec-

ifications, no alarms are present, and no informational results apply, the ALL SUMMARY RESULTS OK message appears in the result pane with a green background (see Figure 29).

When pointer adjustments occur on the circuit, the results are captured in the Summary window.

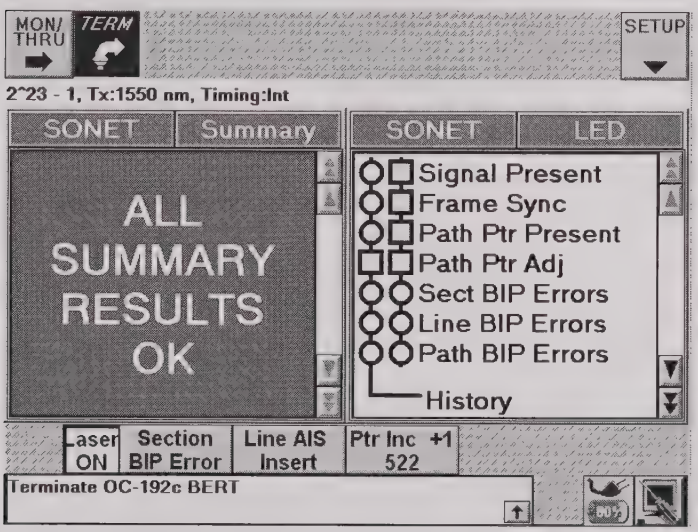



**Figure 29** All Summary Results OK and LED results

When errors are detected, the appropriate test results appear in the Summary results pane and the results pane is red (see Figure ).

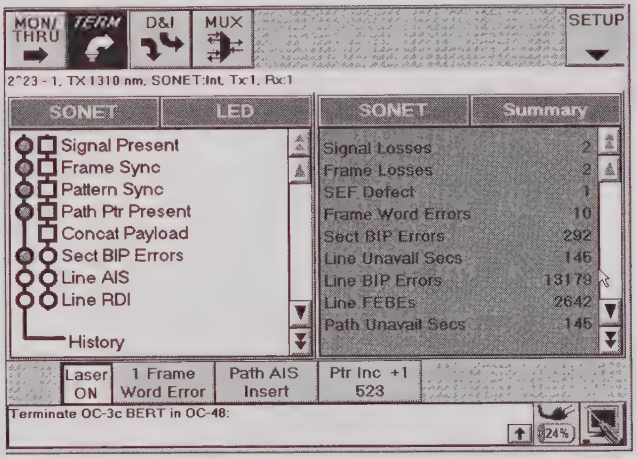



**Figure 30** Summary Results Error display

**NOTE:**

When the TestPad detects an error, the corresponding Summary Alarm LED illuminates on the LED display panel to let you know an error was detected (see Table 15 on page 204).

## LED results

The TestPad offers two types of LED results:

- Current and historical Status and Alarm LED results, displayed on the front panel of the TestPad in the LED display panel.
- LED test results displayed in the Results Panes of the user interface for the LED result category.

## About Status and Alarm LEDs

Current and historical Status and Alarm LEDs are provided on the LED display panel for PRI (primary) and, if applicable, SEC (secondary) signals. Primary LEDs appear on the left side of the panel; secondary LEDs appear on the right side of the panel (see Figure 5 on page 14).

The inside column of LEDs (for both primary and secondary signals) indicate the current condition or state of the signal; the outside column of LEDs indicate the historical condition of the signal.

**NOTE:**

When you perform SDH tests, refer to the SONET Status and Alarm LEDs to determine the state of the signal.

### *Status LEDs*

The inside green LEDs for SIGNAL, FRAME, PATTERN, PATH PTR, VT PTR, and SYNC illuminate when the TestPad recognizes a signal is present and establishes synchronization with the received primary and secondary (optional) signals. If a signal or synchronization is lost, the green Status LED extinguishes, and the red Alarm LED in the history column illuminates indicating an error condition has occurred.

- The PRI status LEDs indicate the status of the signal received through the primary RECEIVE jack. The PRI status LEDs also indicate the condition of the signal dropped from the payload of a higher signal (for example, the condition of a DS3 signal dropped from an OC-3 signal).
- The SEC status LEDs indicate the status of the signal received through the secondary RECEIVE jack.

### *Alarm LEDs*

The red Alarm LEDs illuminate when an error condition, such as a loss of a signal or synchronization occurs. For the SIGNAL, FRAME, PATTERN, PATH PTR, VT PTR, and SYNC LED categories, the red LED illuminates in the outside (History) column. For the SUMMARY, PTR ADJ, and ALARMS LED categories, the red LED illuminates in the inside (Current) column.

If you lose a signal or synchronization, the associated red Alarm LED illuminates. For example, if you establish synchronization with the framing of a signal, the green FRAME status LED in the Current

column illuminates. But, if you lose synchronization with the framing, the green LED extinguishes, and the red FRAME alarm LED in the History column illuminates.

The red Alarm LEDs also illuminate if an error condition occurred in the past. For example, if you lose frame synchronization, and then recover synchronization, the red Alarm LED in the outside History column illuminates to indicate a historical error condition, and the green Status LED in the inside Current column illuminates simultaneously to indicate frame synchronization has been recovered.

Table 15 lists each of the LEDs, the signal or payload they illuminate for, and the criteria for illuminating a Status or Alarm LED.

**Table 15** FST-2310 LEDs

| LED | Signal/Payload | Status | Alarm |
|---|---|---|---|
| SIGNAL | DS1, DS3, SONET & SDH | A signal is present. | Received signal has been lost since the last test restart. |
| FRAME | DS1, DS3, SONET & SDH | Synchronization is established with framing of signal. | Frame synchronization has been lost since the last test restart. |
| PATTERN | DS1, DS3, SONET & SDH | Synchronization is established with BERT pattern. | Synchronization with the received BERT pattern has been lost since the last test restart. |
| SUM-MARY | DS1, DS3, SONET & SDH | N/A | An error has been recorded by the TestPad, as shown in the Results Summary window. |
| PATH PTR | SONET/SDH | Valid SONET or SDH pointer value is present. | An invalid path pointer has been received on the selected receive channel since the last test restart. |
| VT PTR | SONET/SDH | Synchronization is established with SONET or SDH virtual tributary overhead path pointer byte. | The virtual tributary overhead path pointer byte changes after initial synchronization. |
| PTR ADJ | SONET/SDH | N/A | There is a path pointer adjustment on the selected receive channel since the last test restart. |

**Table 15** FST-2310 LEDs (Continued)

| LED | Signal/Payload | Status | Alarm |
|---|---|---|---|
| ALARMS | SONET/SDH | N/A | An AIS (blue alarm), RDI (yellow alarm), or Path-LOP has been detected since the last test restart. |
| SYNC | ATM (DATA) | HEC synchronization is established. | At least seven consecutive errored HECs were received after cell synchronization. This is equivalent to an out of cell delineation (OCD). |
| SUMMARY | ATM (DATA) | N/A | An error has been recorded by the TestPad, as shown in the Results Summary window.<br><br>Synchronization loss is present for 2.5 seconds. Clears when cell synchronization is regained and loss of synchronization is absent for 10 seconds. This is equivalent to a loss of cell delineation failure (LCD FAILURE) indication. |

## About LED Result Categories

In addition to the Status and Alarm LEDs provided in the LED display panel, LED Result Categories are provided for DS1, DS3, SONET, and SDH signal testing. Two columns of LEDs are displayed (see

Figure 31). The LEDs in the column to the left indicate the historical condition of a signal; the LEDs in the column to the right indicate the current condition of a signal.

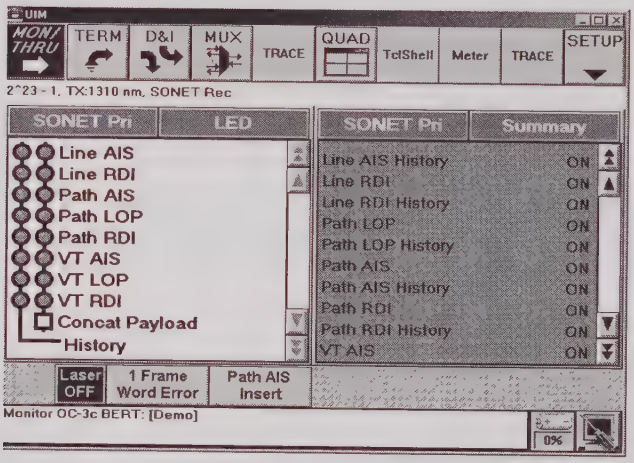



**Figure 31** SONET LED result category

***DS1 LED results***

As the received signal is recognized, the appropriate Status LEDs illuminate on the LED Display Panel. The DS1 LED Category test results are defined in Table 16.

**Table 16** DS1 LED results

| Result | Description |
|---|---|
| Excess Zeros | Excess zeros (more than 7 consecutive) are detected in B8ZS coding and more than 15 in AMI coding. |
| Ones Density | The T1 signal violates the ones density criteria (when there is at least n ones in 8(n+1) bits). |
| Yellow Alarm | Far-End Out-of-Frame (FEOOF) signal is detected. FFOO in FDL for ESF, bit 2 is set to 0 for 255 consecutive DS0 channels for T1-D4. |
| AIS | Unframed pattern is all ones. AIS indicates to downstream equipment that an upstream piece of equipment has detected loss of signal or loss of framing. |

**Table 16** DS1 LED results (Continued)

| Result | Description |
|---|---|
| B8ZS | B8ZS clear channel coding is detected in the received DS1 signal. |
| DS1 Idle | T1 D4 inband (all DS1 channels contain 0001 0111 bit pattern) and T1 ESF out-of-band (FFOO) idle code (Yellow Alarm) is present. |
| Link Ready (ISDN only) | Set Asynchronous Balanced Mode – Extended (SABME) command, Unnumbered Acknowledgement (UA) response, or a Receiver-Ready (RR) Packet is received. The link is considered not ready if a Disconnect Mode (DM) response or a Receiver-Not-Ready (RNR) packet is received, or if the carrier signal is lost for that link. |

***DS3 LED results***

As the received signal is recognized, the appropriate status LEDs illuminate on the LED Display Panel. The DS3 LED Category test results are defined in Table 17.

**Table 17** DS3 LED test results

| Result | Description |
|---|---|
| Far End Alarm | Far-End Alarm and Control (FEAC) messages in the C-bit parity framing format (third C-bit in the M1 subframe) are detected. |
| Blue Alarm | Blue Signal (Alarm Indication Signal) is detected (1010 pattern or stuck C-bit). AIS indicates to downstream equipment that an upstream piece of equipment has detected loss of signal or loss of framing. |
| Yellow Alarm | Far-End Out-of-Frame (FEOOF) signal (X-bits set to zero) is detected. |
| DS2 Frame Loss | Frame synchronization to the DS2 signal is lost. |
| DS2 Frame Sync | Synchronization to the DS2 framing format is present. |
| C-Bit Frame | TestPad acquires C-bit frame synchronization. |
| DS3 Idle | DS3 signal is received in a 1100 pattern aligned in the payload for one M-frame. |

### *SONET LED results*

As the received signal is recognized, the appropriate status LEDs illuminate on the LED display panel. Select **SONET Pri/Sec** from the Result Group for STS-1, OC-3/OC-12/OC-48 results. Select **LED** from the Result Category for test results.

The SONET LED Category results are defined in Table 17.

**Table 18** SONET LED results

| Result | Description |
|---|---|
| Line AIS | Detects a 111 pattern in the Line overhead APS byte (K2), bits 6 to 8, for five consecutive frames. Line AIS is removed after detecting a pattern other than 111 in bits 6-8 of byte K2 for five consecutive frames. Line AIS indicates to downstream equipment that an upstream section terminating equipment (STE) has detected loss of signal or loss of framing. |
| Line RDI | Also known as far-end receive fail (FERF) alarm. Detects a 110 pattern in the Line overhead APS byte (K2), bits 6 to 8, for five consecutive frames. Line RDI is removed after detecting a pattern other than 110 in bits 6-8 of byte K2 for five consecutive frames. Line RDI alerts an upstream device of a downstream failure, such as loss of signal, loss of frame, or Line AIS. |
| Path AIS | Detects an all ones pattern in the Line overhead pointer bytes (H1 and H2) for three consecutive frames. Path AIS is removed when a valid set of pointer bytes and active new data flags (NDFs) are received, or when a valid pointer value is observed in three consecutive frames. Path AIS alerts the downstream path terminating equipment (PTE) that an upstream failure occurred. |
| Path LOP | Occurs when a valid pointer value cannot be determined from the Line overhead pointer bytes (H1 and H2). Specifically, Path LOP is declared if a valid pointer is not found in eight consecutive frames, if eight consecutive active NDFs are received without the corresponding concatenation indication. The Path LOP alarm is removed when a consistent pointer value or concatenation indication is received for three consecutive frames. |

**Table 18** SONET LED results (Continued)

| Result | Description |
|---|---|
| Path RDI | Also known as RAI or Yellow Alarm. Detects a one in bit 5 of the Path status byte (G1) for five consecutive frames. STS Path RDI is removed after bit 5 of byte G1 contains a zero for five consecutive frames. Path RDI indicates to the upstream PTE that a downstream failure has been detected. |
| VT AIS | Detects an all ones pattern in the VT pointer bytes (V1 and V2) for three consecutive VT superframes. VT Path AIS is removed under two conditions: when a valid VT pointer, valid VT size, and the NDF 1001 flag are detected, or three consecutive VT superframes containing a valid VT pointer, valid VT size, and a normal NDF are detected. VT AIS alerts the downstream VT PTE of an upstream failure. |
| VT LOP | Detects a valid pointer value cannot be determined from the VT Path overhead bytes (V1 and V2). Specifically, VT Path LOP is declared if a valid pointer is not found in eight consecutive frames, if eight consecutive active NDFs are received. The VT Path LOP alarm is removed when a consistent pointer value is received for three consecutive frames. |
| VT RDI | Also known as RAI or Yellow Alarm. Detects a one in bit 8 of the VT Path overhead byte (V5) for five consecutive VT superframes. The VT Path RDI alarm is removed when a zero is detected in bit 8 of byte V5 for five consecutive frames. VT RDI indicates to the upstream VT PTE that a downstream failure has been detected. |
| Concat Payload | A concatenated pointer value is detected in the first received STS-1 and NDFs with pointer values of 0 in the remaining STS-1s for three frames. |

### *SDH LED results*

As the received signal is recognized, the appropriate status LEDs illuminate. The SDH LED Category results are defined in Table 19.

**Table 19** SDH LED results

| Result | Description |
|---|---|
| MS AIS | A 111 pattern in the line overhead APS byte (K2), bits 6–8, for five consecutive frames. Line AIS is removed after detecting a pattern other than 111 in bits 6–8 of byte K2 for five consecutive frames. Line AIS indicates to downstream equipment that an upstream section terminating equipment (STE) has detected loss of signal or loss of framing. |
| MS RDI | A 110 pattern in the line overhead APS byte (K2), bits 6–8, for five consecutive frames. Line RDI is removed after detecting a pattern other than 110 in bits 6–8 of byte K2 for five consecutive frames. Line RDI alerts an upstream device of a downstream failure, such as loss of signal, loss of frame, or line AIS. |
| AU-4 AIS | An all ones pattern in the line overhead pointer bytes (H1 and H2) for three consecutive frames. Path AIS is removed when a valid set of pointer bytes and active new data flags (NDFs) are received, or when a valid pointer value is observed in three consecutive frames. Path AIS alerts the downstream path terminating equipment (PTE) that an upstream failure occurred. |
| AU-4 LOP | A valid pointer value cannot be determined from the line overhead pointer bytes (H1 and H2). Specifically, path LOP is declared if a valid pointer is not found in eight consecutive frames, if eight consecutive active NDFs are received without the corresponding concatenation indication. The path LOP alarm is removed when a consistent pointer value or concatenation indication is received for three consecutive frames. |
| AU-4 RDI | A one in bit 5 of the path status byte (G1) for five consecutive frames. STM path RDI is removed after bit 5 of byte G1 contains a zero for five consecutive frames. Path RDI indicates to the upstream PTE that a downstream failure has been detected. |

**Table 19** SDH LED results (Continued)

| Result | Description |
|---|---|
| VT AIS | Detects an all ones pattern in the VT pointer bytes (V1 and V2) for three consecutive VT superframes. VT Path AIS is removed under two conditions: when a valid VT pointer, valid VT size, and the NDF 1001 flag are detected, or three consecutive VT superframes containing a valid VT pointer, valid VT size, and a normal NDF are detected. VT AIS alerts the downstream VT PTE of an upstream failure. |
| VT LOP | Detects a valid pointer value cannot be determined from the VT Path overhead bytes (V1 and V2). Specifically, VT Path LOP is declared if a valid pointer is not found in eight consecutive frames, if eight consecutive active NDFs are received. The VT Path LOP alarm is removed when a consistent pointer value is received for three consecutive frames. |
| VT RDI | Also known as RAI or Yellow Alarm. Detects a one in bit 8 of the VT Path overhead byte (V5) for five consecutive VT superframes. The VT Path RDI alarm is removed when a zero is detected in bit 8 of byte V5 for five consecutive frames. VT RDI indicates to the upstream VT PTE that a downstream failure has been detected. |
| Concat Payload | The concatenated pointer value is detected in the first pointer position of the received STM-Nc channel with valid concatenation indicators detected in the 2nd through Nth pointer positions for at least three consecutive frames.<br>(not applicable for STM 1) |

***ATM LED results***

As the received signal is recognized, the appropriate Status LEDs illuminate. The ATM LED Category results are defined in Table 20.

**Table 20** ATM LED results

| Result | Description |
|---|---|
| Sync Failure | Synchronization loss is present for 2.5 seconds. Clears when cell synchronization is regained and loss of synchronization is absent for 10 seconds. |

**Table 20** ATM LED results (Continued)

| Result | Description |
|---|---|
| PLCP Detected | TestPad has gained PLCP sync. This result only appears if PLCP is ON or in AUTO mode. |
| VP RDI (F4) | VP RDI (F4) cells are being received on the selected VPI. |
| VC RDI (F5) | VC RDI OAM (F5) cells are being received on the selected VPI/VCI. |
| VC AIS (F4) | VC AIS (F4) OAM cells are being received on the selected VPI/VCI. |
| VP AIS (F5) | VP AIS (F5) OAM cells are being received on the selected VPI. |
| LPAC Status | TestPad has not received 2 consecutive unerrored test cells with consecutive sequence numbers during the previous 10 seconds. |

## Signal results

The Signal Category results include signal level, frequency, and loss seconds. The results are accumulated after initial signal detection. Select **T1 Pri/Sec** from the Result Group and **Signal** from the Result Category for Signal Category results.

### DS1 Signal results

The DS1 Signal Category results are defined in Table 21.

**Table 21** DS1 Signal results

| Result | Description |
|---|---|
| Signal Losses | T1 signal is lost or absent (equal to 1 loss in every 100 milliseconds). |
| Signal Loss Secs | Number of seconds during which the received DS1 signal was lost for all or part of a second since initial signal detection. |
| RX Frequency | Frequency of the clock recovered from the received DS1. |

**Table 21** DS1 Signal results (Continued)

| Result | Description |
|---|---|
| TX Frequency | Frequency of the clock as measured from the transmitted data. |
| Simplex Curr mA | DS1 electrical signal received in the primary T1 test, the value is displayed as xxx mA in a range from 10 mA to 200 mA. |
| RX Level dBdsx | DS1 power of signal received in a T1 test. The value is displayed as xxx dBdsx in a range from +6.0 dBdsx to -40.0 dBdsx. |
| RX Level dBm | DS1 power of signal received in a T1 test. The value is displayed as + xx.x dBm in a range from +23.0 dBdsx to -23.5 dBdm. Will only be valid for unframed ones. |
| RX Level Vpp | DS1 power of signal received in a T1 test. The value is displayed as + xx.x V in a range from +12.0 V to 1.0 V. |
| Round Trip Delay | Calculates the round trip delay in microseconds. Must be selected during configuration on the Pattern page. |
| Timing Slips | Number of bit slips (+/-) and frame slips (absolute value) counted when the DS1 test signal slips from the DS1 reference signal after both signals are present simultaneously. Counts from 0 to + or - 192 and then rolls over to 0. Resets to 0 if signal present is lost on the analyzed T1 or on the reference T1. A positive results indicates that the analyzed T1 is faster than the reference T1. |
| Frame Slips | Number of frame slips (absolute value) counted when the DS1 test signal slips from the DS1 reference signal after both signals are present simultaneously. |
| ESF Sync | The current ESF Sync message from the ESF-framed DS1 signal under test. |

## DS3 Signal results

The DS3 Signal Category results are defined in Table 22.

**Table 22** DS3 Signal results

| Result | Description |
|---|---|
| Signal Losses | DS3 signal is lost or absent (equal to 1 loss in every 100 milliseconds). |
| Signal Loss Secs | Number of seconds during which the received DS3 signal was lost for all or part of a second since initial signal detection. |
| RX Frequency | Frequency of the clock recovered from the received data measured in Hz. |
| TX Frequency | Frequency of the clock recovered from the transmitted data measured in Hz. |
| Level Volts | Receive level on the incoming STS-1 represented in volts.<br>Accuracy is (+/-) 10% or 20 millivolts, whichever is greater. Range is .00 to 1.99 Vp, and resolution is 0 millivolts. |
| RX Level dBdsx | DS3 power of the signal received. |
| RX Level dBm | DS3 power of signal received in the primary DS3 test. The value is displayed as + xx.x dBm. This is not a true power measurement and is instead derived from the peak level measurement. |
| Round Trip Delay | Calculates the round trip delay in microseconds. Must be selected during configuration on the Pattern page. |

## SONET Signal results

The SONET Signal Category results are defined in Table 23.

**Table 23** SONET signal results

| Result | Description |
|---|---|
| Signal Losses | Occurs during transition from ON to OFF of SONET signal. |
| Signal Loss Secs | Asynchronous test second in which the appropriate loss of signal was present at least some portion of the second. |

**Table 23** SONET signal results (Continued)

| Result | Description |
|---|---|
| RX Frequency (STS-1) | Total number of STS-1 cycles received during the last second. The resolution is 4 Hz. If the signal is further than (+/ -) 1% from the nominal, a message appears indicating that the signal is not STS-1. |
| RX Frequency (OC-3/12/48) | The total number of OC-3/12/48 cycles received during the last second. If the signal is further than (+/ -) 1% from the nominal, a message appears indicating that the signal is not OC-3/12/48. |
| Round Trip Delay | Calculates the round trip delay in microseconds. Must be selected during configuration on the Pattern page. |
| TX Frequency (STS -1) | The total number of STS-1 cycles transmitted during the last second. |
| TX Frequency (OC-3/12/48) | The total number of OC-3/12/48 cycles transmitted during the last second. |
| STS-1 Level Volts | The receive level on the incoming STS-1 in volts. Accuracy is (+/-) 10% or 20 millivolts, whichever is greater. Range is.00 to 1.99 Vp, and resolution is 10 millivolts. |
| STS-1 Level dBdsx | The receive level on the incoming STS-1 in dBdsx. If the result is too high, the TestPad indicates the signal is too high and out of range. If the result is 0.00 volts, it indicates the signal is too low. |
| STS-1 Power dBm | The receive level on the incoming STS-1 in dBm. This is not a true power measurement and is instead derived from the peak level measurement. If the result is too high, the TestPad indicates the signal is too high and out of range. If the result is 0.00 volts, it indicates the signal is too low. |
| Rx Power Lvl | The receive level on the incoming optical signal (OC-3/12/48) in dBm. The result displayed depends on the wavelength (1550nm or 1310nm) you select on the Tx Wavelength tab when you configure your test. |

**Table 23** SONET signal results (Continued)

| Result | Description |
|---|---|
| BPVs | The number of bipolar violations (BPVs) detected since the beginning of the test. |
| BPV Rate | The ratio of BPVs to received bits since initially acquiring signal presence. |
| BPV Err Secs | The number of seconds during which BPVs occurred since the beginning of the test. |
| BPV % Err Free Secs | The percentage of the number of seconds during which no BPVs occurred since the beginning of the test. |
| Rx Overload | Received optical power level is greater than -6 dBm. The receiver automatically shuts down and `Rx Overload` appears (only applicable with OC-48 equipped TestPads). |

## SDH Signal results

The SDH Signal Category results are defined in Table 24.

**Table 24** SDH signal results

| Result | Description |
|---|---|
| Signal Losses | Occurs during transition from ON to OFF of SDH signal. |
| Signal Loss Secs | Asynchronous test second in which the appropriate loss of signal was present at least some portion of the second. |
| BPVs | The number of bipolar violations (BPVs) detected since the beginning of the test. |
| BPV Rate | The ratio of BPVs to received bits since initially acquiring signal presence. |
| BPV Err Secs | The number of seconds during which BPVs occurred since the beginning of the test. |
| BPV %EFS | The percentage of the number of seconds during which no BPVs occurred since the beginning of the test. |

**Table 24** SDH signal results (Continued)

| Result | Description |
|---|---|
| RX Freq | The total number of STM-1/STM-4/STM-16 cycles received during the last second. If the signal is further than ±1% from the nominal, a message displays indicating that the signal is not STM-1/STM-4/STM-16. |
| TX Freq | The total number of STM-1/STM-4/STM-16 cycles transmitted during the last second. |
| Level Volts | The receive level on the incoming STM-1/STM-4/STM-16 in volts. Accuracy is (+/-) 10% or 20 millivolts, whichever is greater. Range is 0.00 to 1.99 Vp, and resolution is 10 millivolts. |
| Level dBdsx | The receive level on the incoming STM-1/STM-4/STM-16 in dBdsx. If the result is too high, the TestPad indicates the signal is too high and out of range. If the result is 0.00 volts, it indicates the signal is too low. |
| Level dBm | The receive level on the incoming STM-1/STM-4/STM-16 in dBm. This is not a true power measurement and is instead derived from the peak level measurement. If the result is too high, the TestPad indicates the signal is too high and out of range. If the result is 0.00 volts, it indicates the signal is too low. |
| Rx level dBm | The receive level on the incoming optical signal (STM-1/4c/16c) in dBm. |
| Delay usec | Calculates the round trip delay in microseconds. Must be selected during configuration on the Pattern page. |
| APS Switching Time | The measured APS switch time in milliseconds. |
| Rx Overload | Received optical power level is greater than -6 dBm. The receiver automatically shuts down and `Rx Overload` appears (only applicable with OC-48 equipped TestPads). |

## Time results

The Time category lists the current date, time, and the amount of time that has elapsed since the last test restart for DS1, DS3, SONET, SDH, ATM and GR-303 applications. Select the appropriate rate from the Result Group and **Time** from the Result Category to view time results.

The Time Category results are defined in Table 25.

**Table 25** Time results

| Result | Description |
|---|---|
| Time | The current time of day in hours, minutes, and seconds. The time is set on the Time/Date tab. |
| Date | The current day and month. The date is set on the Time/Date tab. |
| Elapsed Time | The elapsed time in hours, minutes, and seconds since the last test restart. |

## BPV results

The BPV Category results include electrical level bi-polar violation measurements. Select T1 Pri/Sec from the Result Group and **BPV** from the Result Category for BPV results.

### DS1 BPV results

The DS1 BPV Category results are defined in Table 26.

**Table 26** DS1 BPV results

| Result | Description |
|---|---|
| BPVs | The number of bipolar violations (BPVs) detected since the beginning of the test. Intentional B8ZS code violations are excluded from the count. |
| BPV Rate | The ratio of BPVs to received bits since initially acquiring signal presence. |

**Table 26** DS1 BPV results (Continued)

| Result | Description |
|---|---|
| BPV Err Secs | The number of seconds during which one or more BPVs occurred since the beginning of the test. |

### DS3 BPV results

The DS3 BPV Category results are defined in Table 27.

**Table 27** DS3 BPV results

| Result | Description |
|---|---|
| BPVs | The number of bipolar violations (BPVs) detected since the beginning of the test. Intentional B3ZS code violations are excluded from the count. |
| BPV Rate | The ratio of BPVs to received bits since initially acquiring signal presence. |
| BPV Err Secs | The number of seconds during which one or more BPVs occurred since the beginning of the test. |

## Frame results

Frame errors begin accumulating after initial frame synchronization on the incoming DS1 signal.

### DS1 Frame results

Select **T1 Pri/Sec** from the Result Group and **Frame** from the Result Category for DS1 Frame results. The DS1 Frame Category results are defined in Table 28.

**Table 28** DS1 Frame results

| Result | Description |
|---|---|
| Frame Losses | A count of discrete losses of frame synchronization since initial frame synchronization or last test restart. |

**Table 28** DS1 Frame results (Continued)

| Result | Description |
|---|---|
| Frame Errors | The number of frame errors detected since initial DS1 frame synchronization. |
| Frame Error Rate | The ratio of frame errors to received framing bits since initially acquiring frame synchronization. |
| Frame Erred Secs | The number of seconds during which one or more frame errors occurred since initial DS1 frame synchronization. |
| Frame Loss Secs | The number of seconds during which one or more frame synchronization losses occurred or during which frame synchronization could not be achieved, since initial DS1 frame synchronization. |
| Frame SES | The number of seconds during which the total number of frame errors equals 12 or more (D4 framing only). |
| CRC Errors | The number of CRC errors detected since initial DS1 frame synchronization. CRC errors are counted only when ESF framing is present in the received T1 data. |
| CRC Erred Rate | The ratio of CRC errors to the number of extended superframes received. |
| CRC SES | The number of seconds during which the total number of CRC errors and frame synchronization losses equaled 320 or more. |
| CRC Erred Secs | The number of seconds during which one or more CRC errors occurred. |

## DS3 Frame results

Select **T1 Pri/Sec** from the Result Group and **Frame** from the Result Category for DS3 Frame results. The DS3 Frame Category results are defined in Table 29.

**Table 29** DS3 Frame results

| Result | Description |
|---|---|
| Frame Losses | The detection of frame synchronization lost since the beginning of the test. |
| DS2 Frame Losses | The number of DS2 frame losses occurring after initial frame synchronization. |
| Frame Errors | The number of frame errors detected since initial DS3 frame synchronization. |
| Frame Error Rate | The ratio of frame errors to received framing bits since initially acquiring frame synchronization. |
| Frame Erred Secs | The number of seconds during which one or more frame errors occurred since initial DS3 frame synchronization. |
| Far-End OOF Sec | The number of seconds during which the received X-bits are zero within the 1 second interval. |
| Near-End OOF Sec | The number of seconds during which an out-of-frame condition or an AIS is detected. |
| DS2 Frame Errors | The number of DS2 frame errors detected since initial DS2 frame synchronization. |
| DS2 Frame Error Rate | The ratio of detected DS2 frame errors to the total DS2 framing bits received. |
| TX X-Bits | The current setting of the transmitted X-bits when in a framed mode. |
| RX X-Bits | The current status of the received X-bits when in a framed mode. The result is available after receiving DS3 frame synchronization. |

**Table 29** DS3 Frame results (Continued)

| Result | Description |
|---|---|
| FEAC, History | The reception of at least two consecutive repetitions of one of the following FEAC messages in the C-bit FEAC channel: |
| | Comm Equip Fail NSA: DS3 Equipment Failure, Service Affecting (Type 1 equipment failure) |
| | DS3 Idle: DS3 Idle Signal Received |
| | DS3 AIS: DS3 Alarm Indication Signal Received |
| | DS3 Out of Frame: DS3 Out-of-Frame, Loss of DS3 Frame Synchronization |
| | DS3 LOS/HBER: DS3 Loss-of-Signal/High Bit Error Ratio |
| | DS3 Equip Fail SA: DS3 Equipment Failure, Service Affecting (Type 1 equipment failure) |
| | DS3 Equip Fail NSA: DS3 Equipment Failure, Non-Service Affecting (Type 2 equipment failure) |
| | Mult DS1 LOS/HBER: Multiple DS1 Loss-of-Signal/ High Bit Error Ratio |
| | Single DS1 LOS/HBER: Single DS1 Loss-of-Signal/High Bit Error Ratio |

**Table 29** DS3 Frame results (Continued)

| Result | Description | |
|---|---|---|
| FEAC, History (continued) | DS1 Equip Fail SA: | DS1 Equipment Failure, Service Affecting (Type 1 equipment failure) |
| | DS1 Equip Fail NSA: | DS1 Equipment Failure, Non-Service Affecting (Type 2 equipment failure) |

## T1 BERT results

The Bridgtap and Multipat result categories provide T1 BERT results.

### Bridgtap results

If you select the Brigtap pattern when you configure a T1 BERT test, bridge tap results accumulate in the Bridgtap category (see Figure 32).

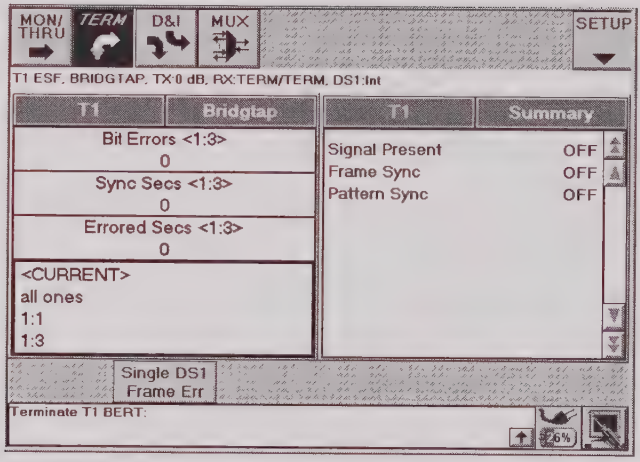



**Figure 32** Bridgtap results

The results appear in sequence for each pattern sent in the BERT. For example, results appear for the all ones pattern, the 1:1 pattern, the 1:3 pattern, and so on.

The top section of the results pane displays the Bridgtap results for the current pattern. The pattern the results apply to is displayed in <> brackets in the result name. For example, the Bit Errors result for the 1:1 pattern displays `Bit Errors <1:1>` as the result name.

The lower section displays patterns that results have already been accumulated for. In Figure 32, results have already been accumulated for `all ones`, `1:1`, and `1:3`. Results have also been accumulated for `1.4`; however, you must tap the down arrow to scroll to the patterns at the bottom of the section. You can view the results recorded for any of the patterns displayed in the lower pane by simply tapping the pattern. To view the results for the current pattern, tap **<CURRENT>**. Use the up and down arrow icons to scroll through the results listed in the lower section.

Results are displayed for the following BERT patterns:

- all ones
- 1:1
- 1:3
- 1:5
- 1:6
- 1:7
- 2:8
- 2:9
- 2:10
- 2:11
- 2:12
- 2:13
- 2:14
- 3 in 18
- 3 in 19
- 3 in 20
- 3 in 21
- 3 in 22
- 3 in 23
- 3 in 24
- QRSS

The Bridgtap category results are defined in Table 30.

**Table 30** Bridgtap results

| Result | Description |
|---|---|
| Bit Errors <pattern> | The number of received pattern bits that have a value opposite that of the corresponding transmitted bit pattern since initial pattern synchronization. |
| Sync Secs <pattern> | The number of seconds during which the receiver has pattern synchronization since initial pattern synchronization. |
| Errored Secs <pattern> | The number of seconds during which one or more pattern bit errors occurred since initial pattern synchronization. |

## Multipat results

If you select the MULTIPAT pattern on the Pattern tab when you configure a T1 BERT, you can view Multipat results.

Selecting the MULTIPAT pattern sends the five most commonly used test patterns automatically. When you configure a MULTIPAT BERT, you can specify which of the five designated patterns (`All Ones`, `1:7`, `2 in 8`, `3 in 24`, or `QRSS`) you want to send, and the duration for the pattern.

The TestPad monitors the received test patterns for bit errors, synchronized seconds, and errored seconds. There may be a slight difference between the synchronized seconds and the duration you specified for

a pattern due to the time the TestPad needs to synchronize between patterns. For example, if you specified that the TestPad should send a pattern for thirty seconds when you configured a test, and the Sync Secs result displays twenty-five seconds, the TestPad took five seconds to synchronize between patterns.

The Multipat Category results are defined in Table 31.

**Table 31** Multipat results

| Result | Description |
|---|---|
| Bit Errors <pattern> | The number of received pattern bits that have a value opposite that of the corresponding transmitted bit pattern since initial pattern synchronization. |
| Sync Secs <pattern> | The number of seconds during which the receiver has pattern synchronization since initial pattern synchronization. |
| Errored Secs <pattern> | The number of seconds during which one or more pattern bit errors occurred since initial pattern synchronization. |

## DS3 Parity results

Parity errors begin accumulating after initial frame synchronization on the incoming DS3 signal. The DS3 PARITY Category results depend on the current framing mode and the received framing signal. Select **DS3 Pri/Sec** from the Result Group and **Parity** from the Result Category for parity results.

The DS3 Parity Category results are defined in Table 32.

**Table 32** DS3 Parity results

| Result | Description |
|---|---|
| Parity Errors | An M-Frame that contains a mismatch between either parity bit (P-bits) and the parity calculated from the information bits in the previous M-frame. |

**Table 32** DS3 Parity results (Continued)

| Result | Description |
|---|---|
| Parity Error Rate | The ratio of parity errors to the number of bits over which parity was calculated. |
| Parity Error Secs | The number of seconds during which one or more parity errors occurred since initial DS3 frame synchronization. |
| C-Bit Errors | An M-Frame that contains a mismatch between the majority rule of the C-bit path parity bits (CP-bits) and the parity calculated from the information bits in the previous M-frame. |
| C-Bit Error Rate | The ratio of C-bit parity errors to the number of bits over which C-bit parity was calculated. |
| C-Bit Error Secs | The number of seconds during which one or more C-bit parity error occurred since initial DS3 C-bit frame synchronization. |
| FEBEs | Far-end block errors (FEBEs) detected since initial DS3 C-bit frame synchronization caused by an M-Frame in which any of the three FEBE bits is a zero. |
| FEBE Rate | The ratio of FEBEs to the number of bits over which C-bit parity was calculated. |
| FEBE Errored Seconds | The number of seconds during which at least one FEBE occurred since initial DS3 C-bit frame synchronization. |

## SONET results

### SONET Section results

SONET Section overhead results enable the TestPad to analyze the SONET section of a network. The results are only available when a SONET option is installed. Select **SONET Pri/Sec** from the Result Group and **Section** from the Result Group for Section results.

The SONET Section Category results are defined in Table 33.

**Table 33** SONET Section results

| Result | Description |
|---|---|
| Frame Word Errors | The number of errored frame alignment signal (FAS) subsets (subset of bytes A1 and A2) received since gaining initial frame synchronization. |
| Section BIP Errors | An error in the even parity Section BIP-8 (B1) byte when used as a parity check against the preceding STS-n frame. Up to eight BIP errors may be counted per STS-n frame. Section BIP errors are only defined for the first STS-1 on an STS-n. |
| Section EQU BIP Error Rate | The ratio of Section BIP Errors to the total number of received bits. |
| Section BIP Error Sec | The number of seconds in which one or more Section BIP errors occurred since test restart. The errored second interval is not synchronous to the occurrence of the BIP error. |
| SEF Defect | Four contiguous errored frame alignment words (A1/A2 pair) are detected. |
| Sect SES | An asynchronous test second in which 2500 or more Section BIP Errors were counted. |
| SEF Secs | An asynchronous test second in which a Severely Errored Frame was counted. |

## SONET Line results

SONET Line overhead results enable the TestPad to analyze the SONET Line of a network. The results are only available when a SONET option is installed. Select **SONET Pri/Sec** from the Result Group and **Line** from the Result Category for SONET Line results.

The SONET Line Category results are defined in Table 34.

**Table 34** SONET Line results

| Result | Description |
|---|---|
| APS Msg Count | The number of transitions occurring in the switch priority field of the line overhead byte (K1), bits 1-4. This is an indication of protection switch activity; it is not a direct count of protection switches. |
| APS Bridged Line | The number of the channel bridged bits 1-4 onto the protection line. If 0, then no line is bridged to the APS line. |
| APS Switch Mode | Displays the current protection switching mode.<br>**K2 Bits 5678** — **Mode**<br>0xxx — Provisioned for 1+1<br>1xxx — Provisioned for 1:n<br>x101 — Bidirectional switching<br>x100 — Unidirectional switching |

**Table 34** SONET Line results (Continued)

| Result | Description |
|---|---|
| APS Request Msg | Displays the current protection switch request message and channel as indicated by the line overhead byte (K1). Each message will have a Channel Number Code Assignment and a type of request. |

| K1 Bits 1234 | Type of Request |
|---|---|
| 1111 | Lockout of Protection |
| 1110 | Forced Switch |
| 1101 | Signal Fail — High Priority |
| 1100 | Signal Fail — Low Priority |
| 1011 | Signal Degrade — High Priority |
| 1010 | Signal Degrade — Low Priority |
| 1001 | (not used) |
| 1000 | Manual Switch |
| 0111 | (not used) |
| 0110 | Wait-to-Restore |
| 0101 | (not used) |
| 0100 | Exercise |
| 0011 | (not used) |
| 0010 | Reverse Request |
| 0001 | Do Not Revert |
| 0000 | No Request |

| 5678 | Channel Number Code Assignment |
|---|---|
| 0000 | Null Channel |
| 0001-1111 | Actual number (1-15) |

| | |
|---|---|
| Line EQU BIP Error Rate | The Line BIP Errors/Total number of received bits in the previous STS-n frame less the SOH.The denominator of the message is the total number of non-section received bits instead of the number of BIPs so that the result is used to approximate overall received bit error rate. This approximation works on the assumption that only 1 bit error occurs per SONET frame per bit position (1-8 or 1-24 for OC-3c/12c/48c). |

**Table 34** SONET Line results (Continued)

| Result | Description |
|---|---|
| Line BIP Error Secs | The number of seconds in which one or more Line BIP errors occurred since initial SONET frame synchronization. The errored second interval is not synchronous to the occurrence of the BIP error. |
| Line BIP Errors | An error in the even parity line BIP-8 (B2) byte when used as a parity check against the preceding STS-1 frame less the SOH. Up to 8 BIP errors may be counted per STS-1 frame. Line BIP errors are defined for all STS-1s on an STS-n. In OC-3c/12c/48c mode, three line BIPs from each STS-1 are treated as one 24 bit BIP, and hence, up to 24 BIP errors may be counted per OC-3c frame. |
| Line SES | The number of seconds in which more than 2500 Line BIP errors occurred in 1 second for an STS-1, OC-1, or OC-3 signal; or more than 10,000 errors occurred for an OC-12 signal. |
| Line Unavailable Secs | The number of seconds in which the line is not available based on counts of consecutive line severely errored seconds, or the presence of an AIS alarm. |
| Line AIS Seconds | Any asynchronous test second in which Line AIS was present for any portion of the test second. |
| Line FEBEs | Occurs if a FEBE count is present in the Z2 byte. |
| Line FEBE Rate | The ratio of line FEBEs to total number of received bits in the previous STS-n frame, less the SONET overhead. |
| Path Ptr Just | The number of times the synchronous payload envelope (SPE) pointer changed since initial SONET frame synchronization. |
| Path Ptr Incs | The number of times the pointer bytes (H1 and H2) indicated an increment to the path payload pointer since initial SONET frame synchronization. |
| Path Ptr Decs | The number of times the pointer bytes (H1 and H2) indicated a decrement to the path payload pointer since initial SONET frame synchronization. |

**Table 34** SONET Line results (Continued)

| Result | Description |
|---|---|
| Path Ptr NDFs | The number of times the pointer bytes (H1 and H2) indicated an active new data flag (arbitrary change in pointer) since initial SONET frame synchronization. An active NDF occurs during a change in payload content, or after an AIS or some other failure condition. If a change in the pointer is detected for three consecutive frames, the change is counted as an NDF, even if the pointer never has an active NDF. |
| Path Ptr Value | The current STS path pointer value from 0 to 782. `UNAVAILABLE` appears under a number of error conditions, such as line AIS, etc. `OUT OF RANGE` appears if the pointer value is outside 0 to 782. |
| Sync Status S1 | The current Sync message from bits 5-8 of S1 byte in the Line overhead. |
| Path Ptr Size | The binary setting of the size bits in the SONET H1 byte. The normal setting for the pointer size bits is 00 to indicate a SONET payload. If the received bits are other than 00, the result appears in the SUMMARY category. |

## SONET Path results

Select **SONET Pri/Sec** from the Result Group and **Path** from the Result Category for SONET Path results.

The SONET Path Category results are defined in Table 35.

**Table 35** SONET Path results

| Result | Description |
|---|---|
| Path BIP Errors | An error in the even parity Path BIP-8 (B3) byte when used as a parity check against the preceding STS-1 frame less the SOH and LOH. Up to 8 BIP errors may be counted per STS-1 frame. Path BIP errors are defined for all STS-1s on an STS-n. In OC-3c/12c/48c mode, the 3 Path BIPs from each STS-1 are treated as one 24 bit BIP and hence up to 24 BIP errors may be counted per OC-3c/12c/48c frame. |
| Path EQU BIP Error Rate | The number of times in which the Path BIP byte (B3) indicates an error in the previous frame since initial SONET frame synchronization. Path BIP Errors are divided by the total number of received bits in the previous STS-n frame less the SOH and LOH. |
| Path BIP Error Secs | The number of seconds in which one or more Path BIP errors occurred since initial SONET frame synchronization. The errored second interval is not synchronous to the occurrence of the BIP error. |
| Path SES | The number of seconds in which 2500 or more Path BIP errors occurred since initial SONET frame synchronization. |
| Path Unavail Secs | The number of seconds in which the path is considered unavailable. It is an asynchronous test second in which a Path BIP Severely Errored Second was counted or Path AIS was present for any portion of the test second. |
| Path AIS Secs | An asynchronous test second in which Path AIS was present for any portion of the test second. |
| Path AIS/LOP Secs | The number of seconds in which one or more Path AIS or LOP occurs. |

**Table 35** SONET Path results (Continued)

| Result | Description |
|---|---|
| Path LOP Secs | Asynchronous test seconds in which a Path LOP was present for any portion of the test. |
| Path FEBEs | The FEBE count present in the Z2 byte. Up to 8 FEBEs errors may be counted per STS-1 frame. |
| Path FEBE Rate | The ratio of FEBEs to (1) the number of bits over which C-bit parity was calculated. |
| STS-1 Signal Label | The payload type being carried in the current position of the current STS. The information is derived from the Path signal label (C2) and VT overhead (V5) bytes. Any C2/V5 combinations which cannot be decoded appear as `UNRECOGNIZED`. |

## SONET Path Trace results

SONET path trace enables one of three default or user-defined messages to be transmitted over the path trace byte (J1) of the inserted STS-1 signal. Select **SONET Pri/Sec** from the Result Group and **Path Trace** from the Result Category for results.

The SONET Path Trace Category results are defined in Table 36.

**Table 36** SONET Path Trace results

| Result | Description |
|---|---|
| Path Trace | The 64-byte path trace ASCII message which is carried in the path overhead byte (J1). |
| STS Path Signal Label | The payload type being carried in the current position of the current STS. The information is derived from the Path signal label (C2) and VT overhead (V5) bytes. Any C2/V5 combinations which cannot be decoded appear as `UNRECOGNIZED`. |

## SONET VT results

The SONET Virtual Tributary overhead results enable the TestPad to analyze the SONET VT of a network. The results are only available when a SONET option is installed. Select **SONET Pri/Sec** from the Result Group and **VT** from the Result Category for SONET VT results.

The SONET VT Category results are defined in Table 37.

**Table 37** SONET VT overhead results

| Result | Description |
|---|---|
| VT BIP Errors | The number of times in which the VT BIP byte (V5, bits 1 and 2) indicates an error in the received signal. A maximum of two VT BIP errors can be counted in each SONET frame. |
| VT EQU BIP Error Rate | Represents the ratio of VT BIP errors to the total of received bits in the previous VT frame. |
| VT BIP Error Secs | The number of seconds in which one or more VT BIP errors, an AIS, or VT LOP occurred. |
| VT SES | The number of seconds in which 600 or more VT BIP errors occurred during a single second. |
| VT AIS/LOP Secs | The number of seconds in which one or more VT AIS or LOP occurs. |
| VT AIS Secs | The number of seconds in which one or more VT AIS occurs. |
| VT LOP Secs | The number of seconds in which one or more VT LOP occurs. |
| VT Unavail Secs | The number of seconds in which the VT path is unavailable. It is an asynchronous test second in which a Path BIP Severely Errored Second was counted or Path AIS was present for any portion of the test second. |
| VT FEBE | The number of VT BIP errors detected by the downstream PTE. It is calculated by summing the FEBE counter of the path status byte (V5, bit 3) from each received VT superframe. |
| VT FEBE Rate | The ratio of VT FEBEs to the total number of received bits in the previous VT frame. |

**Table 37** SONET VT overhead results (Continued)

| Result | Description |
|---|---|
| VT Ptr Just | The occurrence of a VT pointer increment, a VT pointer decrement, or a VT pointer NDF. |
| VT Ptr Incs | An increment of 1 in the SPE pointer that is recognized when a majority vote of the 5 D bits in the V1, V2 bytes indicate an inversion. |
| VT Ptr Decs | A decrement of 1 in the SPE pointer that is recognized when a majority vote of the 5 D bits in the V1, V2 bytes indicate an inversion. |
| VT Ptr NDFs | The presence of an NDF is recognized by an invert of the 4 N bits in the V1, V2 bytes, or when the presence of an new SPE pointer persists for 3 consecutive frames. |
| VT Ptr Value | The current VT pointer value from 0 to 103. `Out Of Range` appears if the pointer value is outside 0 to 103. |

## Analyzing SONET and SDH overhead bytes

You can analyze and manipulate SONET and SDH overhead bytes by selecting the Overhead result category to display Overhead bytes. See Figure 33.

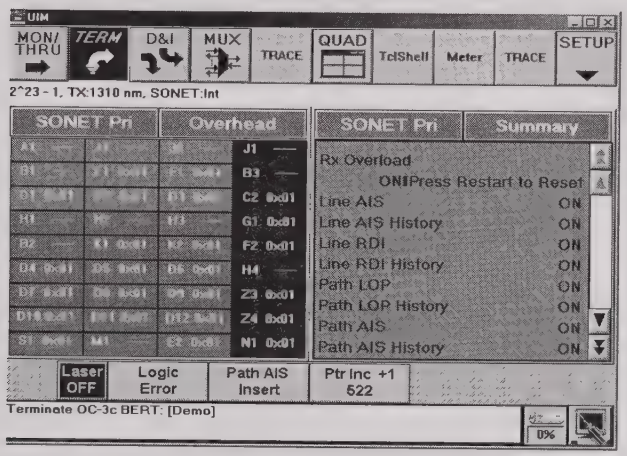



**Figure 33** Overhead byte result view

The bytes are arranged in the standard overhead configuration. ---- indicates that a byte cannot be manipulated or received. For detailed information on manipulating overhead bytes, see "Manipulating overhead bytes" on page 142.

**NOTE:**

You can also view and manipulate overhead bytes on the OH setup tab.

# SDH results

***RSOH results***

The SDH RSOH result category provides similar results to the SONET section results category. The results are only available when the SDH option is installed.

The SDH RSOH Category results are defined in Table 38.

**Table 38** SDH RSOH results

| Result | Description |
|---|---|
| FAS Word Errors | The number of errored frame alignment signal (FAS) subsets (subset of bytes A1 and A2) received since gaining initial frame synchronization. |
| B1 Errors | An error in the even parity BIP-8 (B1) byte used as a parity check against the preceding frame. Up to eight B1 errors may be counted per frame. STM errors are only defined for the first STM-0 on an STM-n. |
| B1 EQU Error Rate | The equivalent ratio of section BIP errors to the total number of received bits in the previous frame, less the SOH. |
| B1 Error Secs | Counts the number of seconds in which B1 errors occur. |
| Sect SES | An asynchronous test second in which 2500 or more B1 errors were counted. |
| OOF | Four contiguous errored frame alignment words (A1/A2 pair) were detected. |
| OOF Secs | An asynchronous test second in which an Out of Frame was counted. |

### *MSOH results*

The SDH MSOH result category provides similar results to the SONET line result category. The results are only available if the SDH option is installed. The SDH MSOH results are defined in Table 39.

**Table 39** SDH MSOH results

| Result | Description |
|---|---|
| MS APS Msg Count | Counts the number of transitions occurring in the switch priority field of the line overhead byte (K1), bits 1-4. This is an indication of protection switch activity; it is not a direct count of protection switches. |

**Table 39** SDH MSOH results (Continued)

| Result | Description |
|---|---|
| MS APS Protection Information<br>(linear protection) | The current protection switch request message and channel as indicated by the line overhead byte (K1). Each message will indicate the type of request and the Channel Number Code Assignment. The 1234 bits describe the type of request, which is described below. The 5678 bits describe the channel number code assignment.<br>**K1 Byte**<br>1234 Type of Request<br>1111 Lockout of Protection<br>1110 Forced Switch<br>1101 Signal Fail — High Priority<br>1100 Signal Fail — Low Priority<br>1011 Signal Degrade — High Priority<br>1010 Signal Degrade — Low Priority<br>1001 (not used)<br>1000 Manual Switch<br>0111 (not used)<br>0110 Wait-to-Restore<br>0101 (not used)<br>0100 Exercise<br>0011 (not used)<br>0010 Reverse Request<br>0001 Do Not Revert<br>0000 No Request<br><br>**5678 Channel Number Code Assignment**<br>0000 Null Channel<br>0001-1111 Actual number (1-15) |

**Table 39** SDH MSOH results (Continued)

| Result | Description |
|---|---|
| MS APS Channel | The current protection switching mode. The 5678 bits describe the mode.<br>**K2 Byte**<br>1234 Channel Numbers (bits 1-4)<br>0000 Null channel<br>0001 Working channel 1<br>0010 Working channel 2<br>. . . . Working channel 3-14<br>1111 Extra traffic channel<br><br>5 MSP Architecture (bit 5)<br>0 1 + 1 architecture<br>1 1 : n architecture<br><br>678 bits 6-8<br>111 MS-AIS<br>110 MS-RDI<br>101 Reserved for future use (planned for bidirectional switching)<br>100 Reserved for future use (planned for unidirectional switching)<br>011 Reserved for future use<br>010 Reserved for future use<br>001 Reserved for future use<br>000 Reserved for future use |
| MS APS Bridged Line | The number of the channel bridged bits 1-4 onto the protection line. If zero, then no line is bridged to the MS line. |

**Table 39** SDH MSOH results (Continued)

| Result | Description |
|---|---|
| APS Protection Channel (ring protection) | The current protection switching mode. The 5678 bits describe the mode.<br>**K2 Byte**<br>1234 Node Identification (bits 1-4)<br>0000 0<br>0001 1<br>0010 2<br>.... 3-14<br>1111 15<br><br>5 Path Code (Bit 5)<br>0 Short Path Code (S)<br>1 Long Path Code (L)<br><br>678 Status (Bits 6-8)<br>111 MS-AIS<br>110 MS-RDI<br>101 Reserved for future use<br>100 Reserved for future use<br>011 Reserved for future use<br>010 Bridged and Switched (Br & Sw)<br>001 Bridged (Br)<br>000 Idle |
| B2 Errors | An error in the even parity line B2 byte used as a parity check against the preceding STM frame less the SOH. Up to eight B2 errors may be counted per STM-0 frame. In STM-1/4c/16c mode, three B2 errors from each STM-0 are treated as one 24 bit B2 error, and hence, up to 24 B2 errors may be counted per STM-1 frame. |

**Table 39** SDH MSOH results (Continued)

| Result | Description |
|---|---|
| B2 EQU Error Rate | The B2 Errors/Total number of received bits in the previous STM-n frame, less the SOH. The denominator of the message is the total number of non-section received bits instead of the number of B2 so that the result is used to approximate overall received bit error rate. This approximation works on the assumption that only one bit error occurs per SOH frame per bit position. The number of B2 bits allowed for each rate are listed below.<br>Rate — Number of B2 bits<br>STM-0 — 8<br>STM-1 — 24<br>STM-4/4c — 96<br>STM-16/16c — 384 |
| B2 Error Secs | Counts the number of seconds in which one or more B2 errors occurred since initial SOH frame synchronization. The errored second interval is not synchronous to the occurrence of the B2 error. |
| MS SES | Counts the number of seconds in which more than 2500 B2 errors occurred in one second for an STM-0 or STM-1 signal; or more than 10,000 errors occurred for an STM-4, or STM-16 signal. |
| MS Unavail Secs | Counts the number of seconds in which the line is not available based on counts of consecutive line severely errored seconds, or the presence of an AIS alarm. |
| MS AIS Secs | Any asynchronous test second in which line AIS was present for any portion of the test second. |
| MS REI | An REI count is present in the Z2 byte. |
| MS REI Rate | The ratio of line REIs to total number of received bits in the previous STM-n frame, less the SOH overhead. |

**Table 39** SDH MSOH results (Continued)

| Result | Description |
|---|---|
| AU-4 Ptr Just | Counts the number of times the synchronous payload envelope (SPE) pointer changed since initial SOH frame synchronization. |
| AU-4 Ptr Incs | Counts the number of times the pointer bytes (H1 and H2) indicated an increment to the path payload pointer since initial SOH frame synchronization. |
| AU-4 Ptr Dec | Counts the number of times the pointer bytes (H1 and H2) indicated a decrement to the path payload pointer since initial SOH frame synchronization. |
| AU-4 Ptr NDFs | Counts the number of times the pointer bytes (H1 and H2) indicated an active new data flag (arbitrary change in pointer) since initial SOH frame synchronization. An active NDF occurs during a change in payload content, or after an AIS or some other failure condition. If a change in the pointer is detected for three consecutive frames, the change is counted as an NDF, even if the pointer never has an active NDF. |
| AU-4 Ptr Value | The current STM path pointer value from 0 to 782. UNAVAILABLE appears under a number of error conditions, such as line AIS. OUT OF RANGE appears if the pointer value is outside 0 to 782. |
| AU-4 Ptr Size | The binary setting of the size bits in the SOH H1 byte. The normal setting for the pointer size bits is 00 to indicate an SOH payload. If the received bits are other than 00, the result appears in the SUMMARY category. |

**Table 39** SDH MSOH results (Continued)

| Result | Description |
|---|---|
| S1 Sync Message | Displays the S1 byte message, carried in bits 5 through 8, after frame synchronization and signal presence are detected.<br>**Bits**<br>5678 Message<br>0000 Quality Unknown (Existing Synchronization Net work)<br>0001 Reserved<br>0010 Rec. G.811 (Primary Reference Clock)<br>0011 Reserved<br>0100 SSU-A (G.812 Transit)<br>0101 Reserved<br>0110 Reserved<br>0111 Reserved<br>1000 SSU-B (G.812 Local)<br>1001 Reserved<br>1010 Reserved<br>1101 Synchronous Equipment Timing Source (SETS) G.813 Option I (SEC)<br>1100 Reserved<br>1011 Reserved<br>1110 Reserved<br>1111 Do Not Use for Synchronization |
| Z1 Byte | Displays the information in the Z1 byte in binary format. |

### *POH results*

The SDH POH result category provides similar results to the SONET path result category. The results are only available if the SDH option is installed. The SDH POH results are defined in Table 40.

**Table 40** SDH POH results

| Result | Description |
|---|---|
| B3 Errors | An error in the even parity path B3 byte used as a parity check against the preceding STM-0 frame less the SOH and LOH. Up to eight BIP errors may be counted per STM-0 frame. In STM-1/4c/16c/64c, three line BIPs from each STM-0 are treated as one 24 bit BIP, and hence, up to 24 BIP errors may be counted per STM-1 frame. Path B3 errors are defined for all STM-1s on an STM-n. |
| B3 EQU Error Rate | An error in the even parity path BIP-8 (B3) byte used as a parity check against the preceding SDH frame less the regenerator and multiplexor OH. Up to eight B3 errors may be counted per SDH frame. Path B3 errors are defined for all STM-1s on an STM-n. |
| B3 Error Secs | Counts the number of seconds in which one or more path B3 errors occurred since initial SOH frame synchronization. The errored second interval is not synchronous to the occurrence of the error. |
| POH SES | Counts the number of seconds in which 2500 or more path B3 errors occurred since initial SOH frame synchronization. |
| POH Unavail Secs | Counts the number of seconds in which the path is considered unavailable. It is an asynchronous test second in which a path B3 severely errored second was counted or AU-4 AIS was present for any portion of the test second. |
| AU-4 AIS Secs | An asynchronous test second in which AU-4 AIS was present for any portion of the test second. |

**Table 40** SDH POH results

| Result | Description |
|---|---|
| AU-4 AIS/LOP Secs | The number of seconds in which one or more AU-AIS or LOP occurs. |
| AU-4 LOP | Counts the number of seconds in which one or more LOP occurs. |
| HP REIs | The REI count present in the Z2 byte. Up to 8 REI errors may be counted per STM-0 frame. |
| HP REI Rate | The ratio of REIs to the number of bits over which C-bit parity was calculated. |
| Signal Label | The type of payload being carried in the selected receive channel. The information is derived from the Path signal label (C2) byte. Any C2 byte that cannot be decoded appears as UNRECOGNIZED. |

***Path Trace results***

The SDH Path Trace result category provides similar results to the SONET Path Trace result category. The results are only available if the SDH option is installed. The SDH Path Trace results are defined in Table 41.

**Table 41** SDH Path Trace results

| Results | Description |
|---|---|
| J1 Trace | The 16 or 64-byte path trace ASCII message that is carried in the path overhead byte (J1). Must be set during configuration on the trace page. |
| J0 Trace | The 16 or 64-byte section trace ASCII message that is carried in the section overhead byte (J0). Must be set during configuration on the trace page. |

***Logic result category***

The SDH logic result category is identical to the DS1, DS3, and SONET logic result categories. See see Table 46 on page 252 for descriptions of the available logic results.

# Channel results

Results for tone analysis and tone noise analysis measurements are presented below.

For Channel VF and DDS results, select the appropriate rate from the Result Group and **Channel** from the Result Category.

## VF and DDS results

The Channel VF and DDS Category results are defined in Table 42.

**Table 42** Channel VF and DDS results

| Result | Description |
|---|---|
| Received Byte | A sampling of the received 8-bit byte of the selected channel. If the received byte is recognized as a control code, the control code name is displayed in the RCODE result. |
| Frequency Hz | The frequency (Hz) of a VF tone within a selected DS0 channel. |
| Level dBm | The level (dBm) of a VF tone within a selected DS0 channel. |
| 3.4K Flat dBrn | The noise (dBm) weighted with a 3 kHz flat filter. Used when qualifying data-grad circuits. |
| 3.4K Notch dBrn | The noise (dBrn) against a weighted 3 kHz flat filter. A transmitted 1004 Hz tone is filtered out prior to the measurement for analog data-grade analysis. This measurement includes quantization noise caused by analog/digital conversion in the CODEC. |
| Cmsg dBrnC | The noise (in dBrnC) weighted with a C-Message filter for voice-grade analysis. This measurement determines the noise on an idle channel. |
| Cnotch dBrnC | The noise (in dBrnC) against a weighted C-message filter. A transmitted 1004 Hz tone is filtered out prior to the measurement for voice-grade analysis. |

**Table 42** Channel VF and DDS results (Continued)

| Result | Description |
|---|---|
| Snr dB | The signal-to-noise ratio of the received signal, assuming a 1004 Hz tone is inserted from an external source. |
| Holding Tone Loss | Occurs when a transmitted 1004 Hz tone is not detected. |
| DDS Control Code | The name of the received DS0 code identified in the DDS Receive Byte. |

## Reportable DS0 control codes

The Reportable DS0 control codes are defined in Table 43.

**Table 43** Reportable DS0 control codes

| Code ID | Control Byte | Description |
|---|---|---|
| ASC | x001 1110 | Abnormal Station Code. Generated by the OCU due to a signal loss from the DSU/CSU, the DSU/CSU isn't attached, or a faulty OCU. |
| C IDLE | x111 1110 | Control Mode Idle. Equivalent to RTS set to OFF. Neither the customer nor the network is using the channel. |
| CHAN | x010 1000 | Alternating Channel (CSU) Loopback. |
| D IDLE | x111 1111 | Data Mode Idle. Equivalent to RTS set to ON, but no data is being sent by the computer. |
| DSU | x010 1100 | Alternating DSU Loopback. |
| FEV | x101 1010 | Far End Voice Byte. Last (Fourth) byte sent in latching loop up sequence. |
| LBE | x101 0110 | Loopback Enable. Third byte sent in the latching loop up sequence. |
| MA | x111 0010 | MJU Alert Code. Second byte sent during an MJU loop up sequence. |
| MAP0 | x001 0011 | MAP 0 Confirmation Code (line/T1 side). Sent by the second DS0-DP being looped. |

**Table 43** Reportable DS0 control codes (Continued)

| Code ID | Control Byte | Description |
|---|---|---|
| MAP1 | x110 1101 | MAP 1 Confirmation Code (drop/DS0 side). Sent by the first DS0-DP being looped. |
| MOS | x001 1010 | Multiplexer Out of Synchronization. Sent by SRMU when it loses subrate frame synchronization. |
| OCU | x010 1010 | Alternating OCU Loopback. |
| RELEASE | x111 1000 | MJU Release Code. |
| TA | x110 1100 | Test Alert. First byte sent during an MJU loop up sequence. |
| TEST | x001 1100 | Test Code. Sent in opposite direction during loop up. |
| TIP | x011 1010 | Transition In Progress. First byte sent during a DDS latching loop up sequence. Also sent for DDS latching loop down. |
| UMC | x001 1000 | Unassigned Multiplexer Channel. Sent by DS0-DP when no OCU-DP installed in channel bank. |

Where x can be any of the following:

- a subrate framing bit when the byte is transmitted or received as a DS0B signal. Framing bit pattern determined by DS0B data rate.
- a *don't care* mode when the byte is received at a DS0A subrate.
- a 1 when the byte is transmitted at a DS0A subrate.
- a 0 when control codes (except IDLE) are transmitted at DS0A 56 kbps rate.
- a **don't care** mode when control codes (except IDLE) are received at DS0A 56 kbps rate.
- a 1 when the IDLE code is transmitted or received at DS0A 56 kbps rate.

## Call Signal results

Results for the Call Signal Category provide a means to scan signaling bit transitions on all channels of a duplex T1 circuit.

Select the appropriate rate from the Result Group and **Call Sig** from the Result Category for Call Signal results. The Call Signal Category test result types are defined in Table 44.

**Table 44** Call Signal results

| Result | Description |
|---|---|
| Signaling Delay | The delay between the conclusion of the previous signaling event/digit and the start of the current signaling event/digit under examination. This result is applicable to all signaling events/digits in the chronological sequence except the first event/digit in the sequence. |
| Signaling Duration | The duration of certain signaling events and all digits in the chronological sequence. This result is applicable for all interpretable digits received, and the signaling events ring, wink, and dial tone. This result is measured in milliseconds. Any result with a value above 9999 milliseconds (~10 seconds) will be flagged as greater than 10 seconds. |

## Traffic results

Results for the Traffic Category provide a means to scan signaling bit transitions on all channels of a duplex T1 circuit. Select the appropriate rate from the Result Group, and select **Traffic** from the Result Category for traffic results.

The Traffic Category test result type is defined in Table 45.

**Table 45** Traffic results

| Result | Description |
|---|---|
| Signaling Bits | The current ABCD signaling bits for either the primary or secondary receivers. This result is available during all T1 signaling tests with T1 frame synchronization. This result is measured as a group. |

## Logic results

Logic errors are based on discrepancies between the transmitted and received bit stream. The accumulation of logic errors is dependent on frame synchronization (if in a framed mode) and pattern synchronization. Logic errors are not available until initial pattern synchronization is obtained. The results are also not available when sending loop codes. During loss of frame or pattern synchronization, the accumulation of errors is halted.

Select the appropriate rate from the Result Group and **Logic** from the Result Category for logic results.

As the received signal is recognized, the appropriate test result appears in the message window. All four rates (DS1/DS3/SONET/SDH) share the same test result messages. The Logic Category results are defined in Table 46.

**Table 46** DS1, DS3, SONET, and SDH Logic results

| Result | Description |
|---|---|
| Pattern Losses | The number of times the received pattern is lost relative to the expected (therefore, internally generated) test pattern. |

**Table 46** DS1, DS3, SONET, and SDH Logic results

| Result | Description |
|---|---|
| Pattern Slips | The number of times the received pattern becomes skewed relative to the expected (therefore, internally generated) test pattern. When a slip is detected, the TestPad automatically re-synchronizes to the received pattern. However, pattern bit errors are not suppressed during this process. Pattern slips are available only when using pseudo-random patterns. |
| Bit Errors | The number of seconds during which one or more pattern bit errors occurred since initial pattern synchronization. |
| Bit Error Rate | The ratio of pattern bit errors to received pattern bits since initially acquiring pattern synchronization. |
| Sync Loss Secs | The number of seconds during which the receiver has lost pattern synchronization, even momentarily, since initial pattern synchronization. |
| Error Secs | The number of seconds during which one or more pattern bit errors occurred since initial pattern synchronization. |
| Error-Free Secs | The number of seconds during which no pattern bit errors are detected while DS1 pattern synchronization is present. |
| % Error-Free Secs | The ratio, expressed as a percentage, of seconds during which no pattern bit errors were detected, to the total number of seconds while pattern synchronization is present. |
| Severely Errored Seconds | Seconds during which the bit error ratio was greater than $10^{-3}$ within available time. This result only applies to DS1 and DS3 rates. |
| Percent Severely Errored Seconds | The ratio, expressed as a percentage, of severely errored seconds to the number of available seconds. This result applies only to DS1 and DS3 rates. |
| Degraded Minutes | Minutes during which the bit rate ratio was greater than $10^{-6}$. This result applies only to DS1 and DS3 rates. |

**Table 46** DS1, DS3, SONET, and SDH Logic results

| Result | Description |
|---|---|
| Percent Degraded Minutes | The ratio, expressed as a percentage, of degraded minutes to the number of available minutes. This result applies only to DS1 and DS3 rates. |
| Unavailable Seconds | A count of unavailable time per CCITT G.821. This result only applies to DS1 and DS3 rates. |
| Percent Availability | The ratio, expressed as a percentage, of available seconds to the number of test seconds. This result applies only to DS1 and DS3 rates. |
| Consecutive Severely Errored Seconds | A count of the number of groups of three or more contiguous seconds in which an error rate greater than $10^{-3}$ was found in each second. This result applies only to DS1 and DS3 rates. |

## ATM results

The ATM categories list errors, statistics, quality of service measurements, and cell type LEDs. To view ATM results, select the ATM result group, then select the category for the results you want to display.

### ATM Errors results

ATM Errors results are defined in Table 47.

**Table 47** ATM Errors results

| Result | Description |
|---|---|
| HEC Errors | Cells with one or more HEC error. |
| Correctable HEC Errors | Cells with only one HEC error. |
| Non-Correctable HEC Errors | Cells with two or more HEC errors. |
| Correctable HEC Rate | The ratio of cells with correctable HEC errors to the number of cells received. |
| Non-correctable HEC Rate | The ratio of cells with non-correctable HEC errors to the number of cells received. |

**Table 47** ATM Errors results (Continued)

| Result | Description |
|---|---|
| PLCP FEBEs | PLCP Far End Block Errors. Counts the PLCP BIP errors that occurred at the far end of a duplex, PLCP-framed, ATM connection. |
| PLCP BIP Errors | The PLP BIP errors on PLCP-framed ATM circuits. |
| PLCP BIP Error Rate | The PLCP BIP error rate based on the PLCP BIP error count. |
| PLCP Frame Word Errors | The number of frame word errors on a PLCP-framed ATM circuit. These errors are determined using a method identical to SONET frame word errors. |

## ATM Stats results

ATM Stats results are defined in Table 48.

**Table 48** ATM Stats results

| Result | Description |
|---|---|
| RX VPI | The VPI currently being analyzed. |
| RX VCI | The VCI currently being analyzed. |
| VPI, VCI % Util | The percentage of all active (non-idle) cells with selected VPI/VCI combinations. |
| VPI, VCI Kbps Util | Approximate bandwidth—in kilobits per second—of all active cells with selected VPI/VCI combinations. |
| VPI, VCI Cells/Sec Util | The percentage of the total bandwidth taken up by cells on the specified VPI/VCI in cells per second. |
| Total % Util | The percentage of all active cells. |
| Total Kbps Util | The approximate bandwidth—in kilobits per second—of all active cells in the payload. |
| Total Cells/sec Util | The percentage of the total bandwidth taken up by all received cells in cells per second. |
| Mask Cells | The number of cells for the specified Rx profile. |

**Table 48** ATM Stats results (Continued)

| Result | Description |
|---|---|
| Active Cells | The number of non-idle cells received. |
| % Mask CLP | The percentage of masked cells matching the current VPI/VCI that have the CLP bit set. |
| Total Congestion % | The bandwidth of all cells marked congested as a percentage of the total active cells, not including idle cells, since initial cell synchronization. |
| Mask Congestion % | The bandwidth of masked cells marked congested as a percentage of total masked cells since the initial cell synchronization. |
| Correlation Tag | The current received TTC cell correlation tag number. The result is only available when a TTC profile is received. |
| Loopback Cells | The number of loopback cells received. |
| Timed-Out Loopback Cells | The number of loopback cells transmitted but not received within the time-out period of 5 seconds. |

## ATM QoS results

ATM QoS results are defined in Table 49.

**Table 49** ATM QoS results

| Result | Description |
|---|---|
| Min Delay Variation (ms) | The minimum time interval between expected cell arrival time (based on Negotiated PCR) and actual arrival time. The TestPad measures 1 pt. CDV. Refer to ITU-T I.356 for more information. |
| Avg Delay Variation (ms) | The average time interval between expected cell arrival time (based on Negotiated PCR) and actual arrival time. The TestPad measures 1 pt. CDV. Refer to ITU-T I.356 for more information. |

**Table 49** ATM QoS results (Continued)

| Result | Description |
|---|---|
| Max Delay Variation (ms) | The maximum time interval between expected cell arrival time (based on Negotiated PCR) and actual arrival time. The TestPad measures 1 pt. CDV. Refer to ITU-T I.356 for more information. |
| Avg Round Trip Delay (ms) | The average time it takes for a transmitted cell to be received back. An estimate of Cell Transfer Delay (CTD) as described by ITU-T I.356 can be determined by dividing the RTD value by 2. |
| Max Round Trip Delay (ms) | The maximum time it takes for a transmitted cell to be received back. An estimate of Cell Transfer Delay (CTD) as described by ITU-T I.356 can be determined by dividing the RTD value by 2. |
| Sev Errd Cell Blk Ratio | Ratio of total severely errored cell blocks to total cell blocks in a population of interest. |
| Misinserted Cells | The number of cells that are received in a stream that were not transmitted as part of that stream at its origination point. This result is a count of TTC 1, TTC 4, and O.191 test cells observed by the receiver, but not transmitted by the TestPad. Specifically, additional cells received in between cells with consecutive sequence numbers. Refer to ITU-T 1.356 and O.191. |
| Cell Misinsert Rate | Ratio of the number of misinserted cells to the elapsed time. Misinserted cells associated with severely errored cell blocks are excluded from the calculation of the cell misinsertion rate. |
| Lost Cells | The number of lost cells. This result is a count of transmitted TTC 1, TTC 4, and O.191 test cells not observed at the receiver, as determined by gaps in the sequence numbers. Refer to ITU-T I.356 and O.191. |
| Cell Loss Ratio | Ratio of lost cells to total cells. Lost cells and transmitted cells in severely errored cell blocks are excluded from the calculation of the cell loss ratio. |

**Table 49** ATM QoS results (Continued)

| Result | Description |
|---|---|
| Out-of-Seq Cells | Count of TTC 1, TTC 4, or O.191 cells received out of order, specifically those with a duplicated or decreasing sequence number. |
| Errored Cells | Counts all TTC #4 or O.191 cells containing CRC errors. May also include O.191, TTC 1, or TTC 4 cells that contain non-consecutive sequence numbers. Refer to ITU-T I.356 and O.191 for more information. |
| Cell Error Ratio | The ratio of the number of errored cells to the total number of successfully transferred cells and errored cells. |

### ATM Cell Type LED results

ATM Cell Type LED results are defined in Table 50.

**Table 50** ATM Cell Type LED results

| Result | Description |
|---|---|
| TTC ANY | A TTC #1 or #4 cell is being received on the selected VPI/VCI. |
| TTC 1 | TTC #1 cells are being received on the last latch interval. |
| TTC 4 | TTC #4 test cells are being received on the selected VPI/VCI. |
| O.191 | O.191 test cells are being received on the selected VPI/VCI. |

## GR-303 results

The GR-303 link statistic, call statistic, and traced call results are detected non-intrusively on the protocol link. To view GR-303 results, select the GR-303 result group, and then select the category for the results you want to display.

## Link stats results

GR-303 link statistic (layer-2 protocol) results are defined in Table 51.

**Table 51** GR-303 link statistics results

| Result | Description |
|---|---|
| Packets | The number of error-free packets with a user-specified SAPI/TEI detected since test restart. If no SAPI/TEI is specified, all packets are counted. |
| CRC Err Packets | The number of packets with CRC errors with a user-specified SAPI/TEI detected since test restart. If no SAPI/TEI is specified, all packets are counted. |
| Packet Error Sec | The number of errored seconds with at least one CRC errored packet. |
| Packet Error Rate | The number of CRC errored packets divided by the sum of total valid packets recognized (Packets + Discarded Packets + any others with a valid SAPI/TEI combination for a GR-303 system) + CRC Err Packets detected since test restart. |
| Discarded Packets | The number of discarded packets since test restart. Discarded packets include packets with seven successive ones (aborts), terminating flag misalignments, sizes that are not a multiple of eight bits, as well as packets that are too long, too short, or otherwise outside of the bounds of legitimacy. |
| Info Packets | The number of error-free information packets with a user-specified SAPI/TEI detected since test restart. If no SAPI/TEI is specified, all information packets are counted. |
| RR Packets | The number of error-free, Receiver-Ready packets with a user-specified SAPI/TEI detected since test restart. If no SAPI/TEI is specified, all RR packets are counted. RR packets act as a "keep-alive" for the protocol link. |
| RNR Packets | The number of error-free, Receiver-Not-Ready packets with a user-specified SAPI/TEI detected since test restart. If no SAPI/TEI is specified, all RNR packets are counted. |

**Table 51** GR-303 link statistics results (Continued)

| Result | Description |
|---|---|
| Reject Packets | The number of error-free Reject packets with a user-specified SAPI/TEI detected since test restart. If no SAPI/TEI is specified, all Reject packets are counted. |
| Link Ready | The virtual LED link activity (active/not active). The link is considered ready if one of the following is received: a Set Asynchronous Balanced Mode - Extended (SABME) command, an Unnumbered Acknowledgement (UA) response, or a Receiver-Ready (RR) packet. The link is considered not ready if a Disconnect Mode (DM) response or a Receiver-Not-Ready (RNR) packet is received, or if the carrier signal is lost for that link. |

## Call stats results

GR-303 call statistic (layer-3 protocol) results from the TMC/CSC are described in Table 52.

**Table 52** GR-303 Layer-3 Call Statistics results

| Result | Description |
|---|---|
| Call Attempts | The number of all call attempts (Setup messages) since test restart. The receipt of each Setup message triggers an increment of one in this count. |
| Call Connects | The number of all calls connected (Connect messages) since test restart. The receipt of each Connect or Connect Acknowledgement message for a specific CRV triggers an increment of one in this count. |
| Call Releases | The number of all calls released since test restart due to a user-specified Cause Value (or ANY Cause Value). The receipt of each Disconnect or Release message for a user-specified CRV (or ANY CRV) triggers an increment of one in this count. |

**Table 52** GR-303 Layer-3 Call Statistics results (Continued)

| Result | Description |
|---|---|
| % Blocked Calls | The ratio of released calls, due to a cause value of 34 (Channel Unavailable), to total calls attempted since test restart. |

## Trace results

GR-303 Trace results from the TMC/CSC are described in Table 53. To view the Results panes for traced calls, see "Tracing calls" on page 178.

**Table 53** GR-303 Call Trace results

| Result | Description |
|---|---|
| Call State | The status of a call, indicated by the last call progression message received for the call. Valid call states are: INITIATED, CONNECTED, DISCONNECTED, and RELEASED. |
| Call Reference Value | The Call Reference Value (CRV) for a traced call. The SETUP message for each call stores an embedded CRV assignment. |
| DS1 Assignment | The DS1 assignment for a traced call. The SETUP message for each call stores an embedded DS1 assignment. The DS1 assignment may also be embedded in a CONNECT message. |
| DS0 Assignment | The DS0 assignment for a traced call. The SETUP message for each call stores an embedded DS0 assignment. The DS0 assignment may also be embedded in a CONNECT message. |
| Cause Value | The cause value for a traced call. The cause value is extracted from the Cause Information element of the first DISCONNECT, RELEASE, or RELEASE COMPLETE message received. |

**Table 53** GR-303 Call Trace results (Continued)

| Result | Description |
|---|---|
| TMC/CSC | The type of call processing method used in the GR-303 interface. Values are TMC (Timeslot management channel) or CSC (Common signaling channel). If the TestPad receives a SETUP message with a Signal element in the message, or if the TestPad detects a SETUP ACKNOWLEDGE, ALERTING, CALL PROCEEDING, or NOTIFY message, the TestPad displays CSC. The TestPad displays TMC for all other traced calls. |

## PRI ISDN results

Results for the Primary Rate ISDN option are displayed in the Terminate mode. There are two types of ISDN results: Physical Interface (T1, DS3, and STS-1)-Relative and Call-Relative.

### ISDN results

The results categories for the Primary Rate ISDN option are described in Table 54.

**Table 54** ISDN PRI category descriptions

| Category | Description |
|---|---|
| Summary Category (Primary/Secondary Result Group) | LAPD Multi-Frame Loss |
| | Call Fail Count |
| | LAPD Protocol Errors |

**Table 54** ISDN PRI category descriptions (Continued)

| Category | Description |
|---|---|
| LED Category | D Channel Ready — A square LED that indicates the datalink is established and ready for call control (Pri/Sec). |
| | Call Connected — A square LED that indicates a call connected for PRI Call 1 or PRI Call 2. |
| | Call Failure — A round LED that indicates PRI Call 1 or PRI Call 2 has been cleared with a cause other then normal. Check Call History. |
| ISDN Stats<br>Layer 2 Category (Primary/ Secondary) | Frame Count — The total number of valid LAPD frames received. |
| | Errored Frames — The number of valid frames with one or more of the following errored conditions: undefined control fields, "S" or "U" frame with incorrect length, or "I" frame with a long information field. |
| | Invalid Frames — The number of frames with FCS errors or invalid SAPI. |
| | Aborted Frames — The number of aborted LAPD frames detected (excluding Out-of-Frame aborts) count. |
| | Reject Frames — The number of LAPD reject frames. |
| | Frame Reject Frames — The number of LAPD frame reject frames. |
| History (Call 1 and Call 2) | Call Failure — Stores up to 12 call attempts (including normal and abnormal call cause codes). |

If a problem with the ISDN PRI line arises, but the physical T1 is working correctly, these messages contain cause codes which are useful for understanding where the fault lies. For statistics about the

physical T1, select **T1 PRI** or **T1 SEC**. For call-specific results such as frame statistics and LAPD statistics for the D channel, select **PRI Call 1** or **PRI Call 2**.

## History

The History category stores and displays up to 12 call attempts (including normal and abnormal call cause codes). Table 55 describes generic ISDN cause codes and messages; Table 56 describes national-specific cause codes and messages.

### *ISDN cause codes*

Table 55 describes the cause codes and the cause messages that are displayed in the Message/Status window. The cause message is shown when the call placed between the PBX and the network fails.

**Table 55** Cause codes descriptions

| Cause Code # | Cause Message — Q.931 Cause Codes (1988) |
|---|---|
| 1 | Unassigned number |
| 2 | No route to specified transit network |
| 3 | No route to destination |
| 6 | Channel unacceptable |
| 7 | Call awarded and delivered in an established channel |
| 16 | Normal call clearing |
| 17 | User busy |
| 18 | No user responding |
| 19 | No answer from user (user alerted) |
| 21 | Call rejected |
| 22 | Number changed |
| 26 | Non-selected user clearing |
| 27 | Destination out of order |
| 28 | Invalid number format |
| 29 | Facility rejected |
| 30 | Response to STATUS INQUIRY |

**Table 55** Cause codes descriptions (Continued)

| Cause Code # | Cause Message — Q.931 Cause Codes (1988) |
|---|---|
| 31 | Normal, unspecified |
| 34 | No circuit/channel available |
| 41 | Temporary failure |
| 42 | Switching equipment congestion |
| 43 | Access information discarded |
| 44 | Requested circuit/channel not available |
| 47 | Resources unavailable, unspecified |
| 50 | Requested facility not subscribed |
| 57 | Bearer capability not presently authorized |
| 58 | Bearer capability not available |
| 63 | Service or option not available, unspecified |
| 65 | Bearer capability not implemented |
| 69 | Requested facility not implemented |
| 79 | Service or option not implemented, unspecified |
| 81 | Invalid call reference value |
| 88 | Incompatible destination |
| 96 | Mandatory information element is missing |
| 97 | Message type non-existent or not implemented |
| 99 | Information element non-existent or not implemented |
| 100 | Invalid information element contents |
| 101 | Message not compatible with call state |
| 102 | Recovery on timer expiry |
| 111 | Protocol error, unspecified |
| 127 | Internetworking |

### *National-specific cause codes*

Table 56 defines national-specific cause values.

**Table 56** National-specific cause codes

| Cause Code # | Cause message — (Defined in TA-NWT-001268) |
|---|---|
| 4 | Vacant code |
| 8 | Prefix 0 dialed in error |
| 9 | Prefix 1 dialed in error |
| 10 | Prefix 1 not dialed |
| 11 | Excessive digits received, call is proceeding |

# Troubleshooting

12

This chapter describes how to identify and correct problems related to the FST-2310. Topics discussed in this chapter include the following:


– "About troubleshooting" on page 268
– "Resolving problems" on page 268

## About troubleshooting

You may experience problems while using the FST-2310. Many of these problems are easily remedied. If you experience significant problems with the FST-2310, contact the Technical Assistance Center (see "Technical assistance" on page xxi).

## Resolving problems

The following section describes common problems that you may encounter while using the FST-2310. Before getting technical assistance, verify that you have exhausted all possibilities.

### Installing and setting up

The unit will not power up.

- Check the power source and restart the unit.
- Verify that the unit is locked between the UIM and the FST-2310. The unit will not power up if the TestPad is not properly assembled. See "Connecting and swapping application modules" on page 22.
- Verify that you are connecting the FST-2310 application module to a Version 6 UIM.

### Operating the TestPad

Test results do not print.

- Verify that the printer cable is properly connected to the TestPad. Refer to "Connecting a printer" on page 42 for instructions on connecting a printer to the TestPad.
- If you are printing to a serial printer, verify that the printer is configured properly. See "Configuring a serial printer" on page 42.
- Verify that the printer is turned on and that it is loaded with paper.

### Performing tests

Test results are inconsistent.

The primary reason for inconsistent test results is improper hookup of the test connectors.

- Verify that the TestPad is connected properly for the test. Refer to "Step 2: Connecting the TestPad for testing" on page 88 for information about test connections.
- Verify that the TestPad is configures properly for the test you are performing.
- If you are performing an optical test, make sure the fiber connectors are clean.

# Customer Services

A

This chapter describes the customer services available through Acterna. Topics discussed in this chapter include the following:


- "About our services" on page 272
- "Customer care" on page 272
- "Global services and solutions" on page 276

## About our services

Acterna offers an unmatched portfolio of services to deploy, support and innovate purchased equipment through its Customer Care and Global Services and Solutions organizations. Customer Care is standard with every product sale and consists of business hours technical assistance, in-warranty repair, calibration, and upgrade services. Global Services and Solutions provides professional services to optimize product capabilities and maximize efficiencies, including field engineering and deployment, technical training, product support, consulting and custom software development. Together these organizations supply the services necessary successfully utilize purchased equipment.

## Customer care

Customer Care is accompanied with the sale of every Acterna product. Customer Care services include:

- Needs Analysis on Products and Services
- Comprehensive Product and Service Literature
- Pre-Sales Consulting
- Technical Assistance (Business Hours)
- Instrument Repair (Under Warranty Repair and Calibration Services)
- Immediate Return Authorizations

Contact a Customer Care representative through your local distributor or by accessing www.acterna.com for information on upgrades, calibration, warranty policies or any of Global Services and Solutions offerings. Representatives also provide assistance with product repairs and returns.

### Technical assistance (business hours)

Expert business hours technical support, including help with product configuration, circuit qualification, and complete network trouble sectionalization is provided with your product (see "Technical assis-

tance" on page xxi). For around-the-clock support, 7x24 technical assistance may be purchased through Global Services and Solutions FleetCare program (see "Product support" on page 278).

## Instrument repair

Our service centers provide repair, calibration and upgrade services for under warranty equipment. Acterna understands the impact of equipment down time on operations and is staffed to ensure a quick turnaround. Available services include the following:

**Product Repair —** All equipment returned for service is tested to the same rigorous standards as newly manufactured equipment. This ensures products meet all published specifications, including any applicable product updates.

**Calibration —** Acterna's calibration methods are ISO 9001 approved and based on NIST standards.

**Factory Upgrades —** Any unit returned for a hardware feature enhancement will also receive applicable product updates and will be thoroughly tested, ensuring peak performance of the complete feature set.

Additional repair, calibration and upgrade services are available for purchase through Global Services and Solutions (see "Product support" on page 278).

## Equipment return instructions

Please contact your local Customer Care location via telephone or web site for Return or Reference Authorization to accompany your equipment. For each piece of equipment returned for repair, attach a tag that includes the following information:

- Owner's name, address, and telephone number.
- The serial number, product type, and model.
- Warranty status. (If you are unsure of the warranty status of your instrument, contact Acterna Customer Care.)
- A detailed description of the problem or service requested.
- The name and telephone number of the person to contact regarding questions about the repair.

– The return authorization (RA) number (US customers), or reference number (European Customers).

If possible, return the equipment using the original shipping container and material. If the original container is not available, the unit should be carefully packed so that it will not be damaged in transit; when needed, appropriate packing materials can be obtained by contacting Acterna Customer Care. Acterna is not liable for any damage that may occur during shipping. The customer should clearly mark the Acterna-issued RA or reference number on the outside of the package and ship it prepaid and insured to Acterna.

## Warranty information

The warranties described herein shall apply to all commercially available Acterna products. Any additional or different warranties shall apply only if agreed to by Acterna in writing. These warranties are not transferable without the express written consent of Acterna.

**Hardware Warranty** — Acterna warrants that Hardware Product sold to customer shall, under normal use and service, be free from defects in materials and workmanship. Information regarding the specific warranty period for this product can be obtained by contacting your local Acterna Customer Service Representative, or at our web site www.acterna.com. If installation services have been ordered, the warranty period shall begin on the earlier of (1) completion of installation, or (2) thirty (30) days after shipment to Customer. If Installation Services have not been ordered, the warranty period shall begin upon shipment to Customer. Hereafter these periods of time shall be collectively referred to as the "Initial Warranty Period."

Acterna's obligation and customer's sole remedy under this Hardware Warranty is limited to the repair or replacement, at Acterna's option, of the defective product. Acterna shall have no obligation to remedy any such defect if it can be shown: (a) that the Product was altered, repaired, or reworked by any party other than Acterna without Acterna's written consent; (b) that such defects were the result of customer's improper storage, mishandling, abuse, or misuse of Product; (c) that such defects were the result of customer's use of Product in conjunction with equipment electronically or mechanically incompatible or of an inferior quality; or (d) that the defect was the result of damage by fire, explosion, power failure, or any act of nature.

Acterna performed repairs shall be warranted from defective material and workmanship for a period of ninety (90) days, or until the end of the Initial Warranty Period, whichever is longer. Risk of loss or damage to Product returned to Acterna for repair or replacement shall be borne by customer until delivery to Acterna. Upon delivery of such product, Acterna shall assume the risk of loss or damage until that time that the product being repaired or replaced is returned and delivered to customer. Customer shall pay all transportation costs for equipment or software shipped to Acterna for repair or replacement. Acterna shall pay all transportation costs associated with returning repaired or replaced product to customer.

**Software Warranty —** Acterna warrants that Software Products licensed to Customer shall, under normal use and service, and for a period of ninety (90) days from the date of shipment of the Software to Licensee (the "Warranty Period"), perform in all material respects in accordance with the published specifications for such Software as established by Acterna. However, Acterna does not warrant that the Software will operate uninterrupted or error free, operate in the combination with other software, meet Customer's requirements, or that its use will be uninterrupted.

Acterna's obligation and Customer's sole and exclusive remedy under this Software Warranty is limited to, at Acterna's option, either (i) correcting the material errors reported to Acterna in writing by Customer during the Warranty Period and which Acterna is able to reproduce, (ii) replacing such defective Software, provided that Acterna received written notice of such defect within the Warranty Period, or (iii) provided that Acterna received written notice of such defect within the Warranty Period, terminating the License and, upon return to Acterna of the Software, Documentation and all other materials provided by Acterna under the applicable License, providing Customer with a refund of all charges paid with respect thereto. Acterna shall have no warranty obligations hereunder if (a) the Software is altered or modified or is merged with other software by Customer or any third party or (b) all or any part of the Software is installed on any computer equipment other than the Designated Server or used with any operating system for which the Software is not designed.

**Services Warranty —** Acterna warrants that the Services provided by Acterna, if any, shall be performed promptly, diligently and in a professional manner in accordance with the commercial standards of the industry. Acterna shall not, however, be respon-

sible for any delays that are not due to Acterna's fault or negligence or that could not have reasonably been foreseen or provided against.

**WARRANTY DISCLAIMER —** FOR HARDWARE, SOFTWARE, AND/OR SERVICES FURNISHED BY ACTERNA, THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTEES AND CONDITIONS, EXPRESS OR IMPLIED. ACTERNA SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, ON ANY HARDWARE, SOFTWARE, DOCUMENTATION OR SERVICES INCLUDING BUT NOT LIMITED TO WARRANTIES RELATING TO QUALITY, PERFORMANCE, NONINFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, AS WELL AS THOSE ARISING FROM ANY COURSE OF DEALING, USAGE OR TRADE PRACTICE. UNDER NO CIRCUMSTANCES WILL ACTERNA BE LIABLE FOR ANY INDIRECT OR CONSEQUENTIAL DAMAGES RELATED TO BREACH OF THIS WARRANTY.

## Global services and solutions

Global Services and Solutions markets a broad portfolio of services to enable customers to aggressively build their competitive advantage within the markets they serve. Global Services and Solutions innovative offerings respond to our customers' dynamic needs:

- System deployment and field engineering services
- Technical training
- Product support
- Consulting
- Custom software development
- Integrated service programs

Additional information can also be found on our web site under Services.

## System deployment and field engineering

Acterna offers a range of support services for our centralized test systems, designed around the needs of the customer's network. Field engineering and deployment services provide a variety of options for implementing the test system into the network.

**Deployment —** Thorough deployment process covers the initial site survey through hardware and software installation, allowing rapid integration of systems product into customers' environment without the use of their own resources. Deployment includes survey, configuration, installation of hardware and software, site planning, cabling, acceptance testing, staging, certification and system documentation.

**Basic Service for Systems —** In today's fast-paced world of communications, network operators are deploying increasingly complex communications test and management systems. Acterna's Basic Service for Systems is designed to provide the system experts, support and methodologies to facilitate the integration of systems products into customers' environments. Basic Service for Systems encompasses system deployment, training, software upgrades, technical assistance and repair. This service is subject to availability, please visit www.acterna.com or contact Customer Care for additional information.

## Training

Acterna delivers training in instructor-led or alternative learning formats that are flexible, convenient, and timely. Our training solutions portfolio consists of network-specific test and management tools for optical transport, cable, access, data, and wireless environments.

### *Instructor-led training*

**Public courses (Acterna sites)**

Public courses help participants quickly acquire fundamental skills or broaden their communications knowledge with advanced instruction. Our courses deliver the ideal mix of theory and practice.

**On-site training (Customer site)**

Acterna provides practical, customized instruction at the customer's designated site. Whether your goal is to shorten turn-up times or increase operation-wide efficiency, on-site training can be a cost-effective way to train from one to 10 participants. Prior to training, the instructor contacts the customer to ensure the course content is aligned with the organization's training needs. We conduct step-by-

step reviews of current technologies and products to help both new and experienced technicians translate theory into practical, hands-on expertise.

When scheduling an on-site course, please note that Acterna requires a minimum commitment of two consecutive days of training. Courses that are only one day in duration may either be paired with another course for a minimum total of two training days, or presented on two consecutive days to different groups of participants.

*Alternative learning*

**Courseware licensing program and train-the-trainer**

Recommended for customers with internal training departments, Acterna's Courseware Licensing Program is a fast, affordable alternative that allows our customers to train their own staff using Acterna's courseware. Each course provides comprehensive instructor and participant materials to ensure consistent content delivery for the length of the agreement. A critical part of Courseware Licensing is the Train-the-Trainer program, which prepares the organization's own instructors to deliver Acterna training courses. Courseware Licensing is sold in increments of one, two, or three years.

**Computer-based training (CBT)**

By blending learning with technology, Acterna's CBT program provides our customers with a cost-effective way to learn technology fundamentals and product applications. Topics include ATM, Frame Relay, ISDN, LAN Basics, Fiber Optics, and more. CBTs are designed to complement both public and on-site training; they can serve to prepare students for classroom Acterna courses or be used after instructor-led training to reinforce learning. In addition to our pre-packaged CBTs, Acterna custom-develops CBTs to meet your organization's training needs.

To enroll in a course or for more information on the variety of Acterna training programs available, call 1-800-638-2049 or visit www.acterna.com and complete the Training Requirement Form.

## Product support

To continue repair, maintenance and upgrades after a product's warranty expires, Acterna offers a variety of product support plans.

**FleetCare —** Designed for customers with ten or more Acterna products, FleetCare extends each product's initial factory warranty to include repair parts, labor and one-way shipping. FleetCare allows customers to upgrade the base package with a variety of options, including Calibration Plans, Calibration Plan with Manager, Loaners, 7x24 Technical Assistance and Software Enhancement Agreements.

**Software Enhancement Agreements —** In response to new developments in technology, Acterna continually upgrades and revises the software that drives many of its products. Software Enhancement Agreements automatically ships the latest software revisions, releases and upgrades to ensure products are operating at the most technologically advanced level.

**Product Maintenance Agreements —** Yearly repair and calibration maintenance agreements simplify billing and help ensure equipment is always operating at optimum levels. Product maintenance agreements can be used to extend a current warranty or provide protection for out-of-warranty units.

**Repair Pricing Options —** For out-of-warranty repairs, Acterna offers two additional pricing options: time and material pricing and flat rate pricing. Under time and material pricing, customers are billed for the actual cost of the repair, making this a cost-effective method for minor repairs. Under flat rate pricing, customers pay a fixed service charge to repair unit failures (excluding damage or abuse).

## Consulting services

To quickly improve our customer's efficiency and productivity, Acterna offers personalized consulting programs designed to meet specific client needs. Our consulting staff will work as part of your team, providing a valuable blend of subject matter proficiency, an in-depth test and measurement systems perspective, and trusted telecommunications industry vision.

**Methods and Procedure Development —** Acterna's Methods and Procedure Development services include consulting with your staff and assessing your network plant's current test and turn-up procedures. After evaluating the skill level of your workforce in specific technologies and procedures, an Acterna team of experts identifies potential areas of improvement and makes appropriate recommendations in a formal implementation plan. Depending on your staff 's level of expertise, test procedures can be written to any level of detail, from

general methods and procedures to detailed "button-by-button" test and network equipment-specific procedures. In addition, Acterna's experts offer hands-on training for your field technicians and can resolve specific problems at the central office. Acterna develops test plans and procedures for Service Providers, End-users and Manufacturers of Network Equipment.

**Test Automation —** With Acterna's Test Automation Development, a team of experts can develop customized automated and remote testing solutions so that you can keep your network functioning at peak levels. After consulting with you, the Acterna team can determine which of Acterna's test and analysis equipment and automation platforms can best streamline your testing processes, data analysis, and test result storage methods. The consulting team can develop and integrate automated testing applications on customers' currently installed computer platforms that match existing methods and procedures. An Acterna team of consultants can assist customers throughout every stage of the development and implementation of automated and remote testing solutions. Services range from developing automated scripts to integrating customized software applications to developing drivers to automated manufacturing tests.

**On-site Test and Measurement Service —** Acterna On-site Test and Measurement Service provides testing expertise to expedite the implementation, turn-up, and provisioning of network services. Applying their knowledge to your specific network requirements, Acterna's network consultants can quickly verify transmission systems' implementation, assess a fiber plant's suitability for advanced services, future-proof your system. Because incomplete testing often results in crippling losses of revenue, carriers and providers must operate their networks with a very low margin of error. Difficulties in ensuring network performance are further compounded when technicians must employ unfamiliar yet critical test and measurement processes. But with Acterna's dedicated, highly skilled team of professionals providing communications test and measurement solutions, your staff can concentrate on performing value-added services that will maximize your profitability.

## Integrated service programs

**Service Dollars (North America only) —** To deliver the highest level of support with your product purchase, Acterna offers Service Dollars. Services Dollars can be purchased at anytime, for each Acterna instrument. If purchased at the same time as your product, Service Dollars

are discounted 20 percent. This is a significant savings, as Service Dollars can be used towards the purchase of any of Global Services and Solutions offerings. Service Dollars are also flexible in the fact that they can be purchased at anytime and then used later towards the specific service that best fits your support needs.

# Specifications

B

This appendix describes the specifications for the FST-2310 and its options. Topics discussed include the following:


- "Physical specifications" on page 284"
- "Environmental specifications" on page 284
- "Electrical specifications" on page 285
- "DS1 input specifications" on page 285
- "DS1 output specifications" on page 286
- "DS3 and STS-1 input specifications" on page 287
- "DS3 and STS-1 output specifications" on page 288
- "Optical specifications" on page 289

## Physical specifications

The physical characteristics for the FST-2310 are described in Table 57.

**Table 57** Physical characteristics for FST-2310

| Item | Description |
|---|---|
| Height | 7.5 in. (19 cm) |
| Width | 11.5 in. (29.2 cm) |
| Depth | 2.25 in. (5.7 cm) |
| Weight | 5 lb. (2.27 kg) |

## Environmental specifications

The environmental characteristics for the FST-2310 are described in Table 58.

**Table 58** Electrical characteristics for FST-2310

| Item | Description |
|---|---|
| Temperature | |
| – Operating | 32° F to 113° F (0° C to +40° C) |
| – Storage | -4° F to 158° F (-20° C to +70° C) |
| Humidity | 10% to 90% Relative Humidity, non-condensing |
| Shock and vibration | Meets IEEE-743 |

## Electrical specifications

The electrical characteristics for the FST-2310 are described in Table 59.

**Table 59** Electrical characteristics

| Item | Description |
|---|---|
| Battery | Rechargeable10.8 V Nickel-Metal Hydride (NiMH) |
| – Operating time | Typically provides up to 1.5 hours of operation performing DS3/DS1 tests<br>Typically provides up to 30 minutes of operation performing STS-1 and OC-3/12 SONET tests<br>Typically provides up to 25 minutes of operation for OC-48 SONET tests |
| – Recharging period | Maximum of 1.5 hours |
| AC adaptor | 19 VDC, 2.95 amps; 100 - 240 VAC, 50 - 60 Hz |
| Cable | 75 Ohm RG59 B/U cable, attenuation measured at 22.368 MHz is 5.7 ± 0.2 dB per 450 ft. of cable |

**NOTE:**

The battery life may decrease after 100 charge/discharge cycles.

## DS1 input specifications

The input specifications for DS1 are described in Table 60.

**Table 60** Input specifications for DS1

| Item | Description |
|---|---|
| Connector type | Bantam jack |
| Frequency | 1.544 MHz ± 50 ppm |
| Impedance | |
| – BRIDGE | 1000 ohms minimum |
| – TERM | 100 ohms ±5% |
| – DSX-MON | 100 ohms ±5% |
| Range | |
| – BRIDGE | +3 to -35.0 dBdsx |
| – TERM | +3 to -35.0 dBdsx |
| – DSX-MON | -10 to -26.0 dBdsx of resistive loss |
| Jitter tolerance | |
| – Per reference | Bell PUB 62411 - 1990 |
| Accuracy | |
| – Receive level measurement | From 6 dBdsx to -15 dBdsx, accuracy of ±1 dB<br>From -16 dBdsx to -30 dBdsx, accuracy of ±2 dB<br>From -31 dBdsx to -40 dBdsx, accuracy of ±3 dB |
| – Simplex current measurement | ± 2% or ±2 mA up to 60 mA<br>± 3% or ±3 mA up to 61 mA to 175 mA |
| – Receive frequency measurement | ± 3 ppm ±1 ppm per year |

## DS1 output specifications

The output specifications for DS1 are described in Table 61.

**Table 61** Output specifications for DS1

| Item | Description |
|---|---|
| Connector type | Bantam jack |
| LBO level | Line Build Out (LBO) of 7.5, 15.0, and 22.5dB measured in a 3kHz ± 1kHz band centered at 772kHz |
| LBO tolerance | ±2 dB at 7.5, 15.0, and 22.5 dB |
| Internal timing | ± 3 ppm ± 1 ppm per year |
| Line codes | AMI or B8ZS |
| Error insert type | Logic, BPV, or Frame |
| Pulse shape | With output terminated in 100 ohms resistive load and 0 dB line build-out selected, the FST-2310 meets ITU-T Recommendation G.703; AT&T Publications CB113, CB119, ANSI T1.403-1995, CB132, CB143, and PUB62508; and AT&T PUB62411 pulse shape specifications |

## DS3 and STS-1 input specifications

The input specifications for DS3 and STS-1 are described in Table 62.

**Table 62** Input specifications for DS3 and STS-1

| Item | Description |
|---|---|
| Connector type | Two WECO 560A connectors |
| Input level range | |
| – HIGH | Accepts a nominal signal level of 1.2 Vp (0 feet of cable attenuation from a HIGH source). With cable attenuation, accepts signal levels from +5dB (-450 feet) of gain to -5 dB (450 feet) of loss from the nominal signal level (1.2 Vp). With resistive attenuation, accepts signal levels from +5 dB of gain to -28 dB of loss from the nominal signal level (1.2Vp) |

**Table 62** Input specifications for DS3 and STS-1 (Continued)

| Item | Description |
|---|---|
| – DSX | Accepts a nominal signal level of 0.6 Vp (450 feet of cable attenuation from a HIGH source). With cable attenuation, accepts signal levels from +5 dB (-450 feet) of gain to -5dB (450 feet) of loss from the nominal signal level (0.6 Vp). With resistive attenuation, accepts signal levels from +6 dB of gain to -26 dB of loss from the nominal signal level (0.6 Vp) |
| – LOW | Accepts a nominal signal level of 0.3 Vp (900 feet of cable attenuation from a HIGH source). With cable attenuation, accepts signal levels from +5 dB (-450 feet) of gain to -5 dB (450 feet) of loss from the nominal signal level (0.3 Vp). With resistive attenuation, accepts signal levels from +5 dB of gain to -5 dB of loss from the nominal signal level (0.3 Vp) |
| Input impedance | 75 ohms nominal, unbalanced to ground<br>Per applicable specifications |
| Jitter tolerance | Exceeds TR-TSY-000499 |

**NOTE:**

The maximum signal that the TestPad can recover without errors is 1.7 Vp. The minimum signal that the it can recover without errors is 0.025 Vp. The maximum input signal level is 2.5 Vp.

## DS3 and STS-1 output specifications

The output specifications for DS3 and STS-1 are described in Table 63.

**Table 63** Output specifications for DS3 and STS-1

| Item | Description |
|---|---|
| Connector type | One WECO 560A connector |

**Table 63** Output specifications for DS3 and STS-1

| Item | Description |
|---|---|
| Output level range | |
| – HIGH | Nominal 1.20 Vp. DS3 Signal meets ANSI T1.102-1993, Table 5, and CCITT Recommendation G.703 for DS3 pulse mask when transmitted through 450 feet of coaxial cable (WECO 728A, RG59B/U, or equivalent). STS-1 pulse mask meets BELL CORE GR-253-CORE-1995 and the DS3 ANSI T1.102-1993 |
| – DSX | Nominal 0.61 Vp. DS3 Signal meets ANSI T1.102-1993, Table 5, and CCITT Recommendation G.703, Section 5. The STS-1 signal meets ANSI T1.102-1993 and BELL CORE GR-253-CORE-1995 |
| – LOW | Nominal 0.31 Vp. Signal is equivalent to a DSX signal transmitted through 450 feet of coaxial cable (WECO 728A, RG59B/U, or equivalent) |
| Output impedance | 75 ohms nominal, unbalanced to ground<br>Per applicable specifications |
| Jitter transfer | Per TR-TSY-000499 |
| Frequency | DS3 = 44.736 MHz ± 10 ppm<br>STS-1 = 51.84 MHz ± 3 ppm ± 1 ppm per year |

## Optical specifications

The optical specifications for OC-3, OC-12, and OC-48, and STM-1, STM-4, and STM-16 are described in Table 64.

## Table 64 Optical specifications

| Item | Description |
|---|---|
| Optical connector types [a] | OC-3/12/48 Receive — FC, SC, or ST<br>OC-3/12/48 Transmit — FC, SC, or ST |
| Transmit measurement range<br>Uses either 1310 or 1550 wavelengths | Transmitter works with multimode or single mode fiber |
| – Output level for OC-48/12/3 modules [b, c] | +3 to -3.0 dBm |
| – Output level for OC-12/3 and OC-3 modules | - 8.0 to -15 dBm |
| – Eye diagram | Per BELL CORE; GR-253-CORE-1995 |
| – Clock frequency accuracy | ± 3 ppm ± 1 ppm per year |
| Receive measurement range | Receiver works with singlemode or multimode fiber. |
| – Receive level sensitivity | - 8 dBm to -28 dBm |
| – Frequency range for OC-48 equipped units | ± 100 ppm year |
| – Frequency range for OC-3 equipped units | ± 500 ppm year |
| – Frequency range for OC-3/12 equipped units | ± 500 ppm year |
| – Frequency measurement accuracy | ± 3 ppm ± 1 ppm per year |
| – Jitter tolerance | Per BELL CORE; GR-253-CORE-1995 |
| – Receiver shutdown [c] | -6 dBm |
| – Reflectance for OC-3/12/48 equipped units | < = -15dBm |
| Level measurement | |
| – Range for OC-48 equipped units | - 6 to -28 dBm |
| – Range for OC-3 and OC-3/12 equipped units | - 5 to -45 dBm |
| – Accuracy | ± 2 dB |
| – Resolution | ± 0.1dB |

a. Never remove laser connectors to clean the optical fiber. Damage to the optics may occur if this is done. Refer all servicing to qualified Acterna service personnel.

b. On OC-3 or OC-3/12 equipped modules, the only transmitter provided meets the low-power specification. A high-power transmit is only provided with modules equipped up to OC-48.

c. A greater than –8 dBm optical-level signal should not be input into the module. Damage to the receiver may occur. The module is shipped with an attenuator for loopback and low power applications.

# Setup Descriptions

This appendix provides key descriptions for the setup tabs you use to configure the FST-2310 for testing.

# Setup descriptions

**Alarm tab —** Select the alarm to simulate during a test. When an alarm is selected, an action button for that alarm appears. Select the action button to simulate the alarm.

**Alarm Type —** OAM tab. Select the option for the alarm type (AIS or RDI) and path or channel designation (VP or VC) to transmit alarm cells. The selected alarm type appears as an action button. Select the action button to insert the alarm.

**APS tab —** Specify the type of APS measurement (Frame Sync, MS AIS, or AU-4 AIS).

**ATM Profiles tab —** The TestPad stores four user programmable virtual path identifier (VPI) and virtual channel identifier (VCI) transmit profiles, and one receive profile.

- Specify the interface: UNI or NNI
- Specify Scramble as ON or OFF
- Enter a specific value for GFC, PTI, and CLP for each profile.
- Specify the profile representing the ATM connection

**ATM tab —** Specify the transmit/receive cell type, PLCP, negotiated PCR, and ATM search type for the cells you are searching for.

**ATM Search Type —** ATM tab. Select the type of ATM cell you are searching for.

- Any TTC Test Cell
- Any Test Cell
- TTC 1 Cells
- TTC 4 Cells
- 0.191 Cells
- Bert Cells
- AIS Cells
- RDI Cells
- Live Traffic Cells

**ATM Tx tab —** Specify CBR or VBR for the primary profile cells, then specify the bandwidth in percentage, bps, or cells/sec for the primary and secondary Tx profile cells. If you are transmitting VBR traffic on the primary transmit profile, specify the burst length and burst gap for the VBR traffic. Also, specify the correlation tag.

**Beep On Error —** Set the TestPad to beep when an error is detected.

**Bit Rate —** ATM Tx tab. Set the TestPad to transmit constant bit rate (CBR) or variable bit rate (VBR) traffic for the primary transmit profile. If you select VBR traffic, you must specify the peak bandwidth, burst gap, and burst length for the variable traffic.

**Buffer Wrap tab —** The TestPad keeps a buffer of ISDN decodes. Select ON to overwrite the oldest file(s) when the buffer is full. When wrap is OFF, no more files can be added.

**Burst Gap (sec) —** ATM Tx tab. Specify the interval (seconds) between transmissions of VBR traffic on your primary tx profile.

**Burst Length (sec)** — ATM Tx tab. Specify the duration (in seconds) to transmit VBR traffic on your primary transmit profile.

**Call Type** — Trace tab. To trace digital or analog calls, select Call Type, and select the arrow to the right of the field to select Digital (ISDN) or Analog (POTS).

**Cause Value Filter** — GR-303 tab. Specify the cause code.

- 16 — normal clearing
- 27 — destination out of service
- 30 — Response to STATUS ENQUIRY
- 34 — channel unavailable
- 41 — temporary failure
- 44 — line unit unavailable
- 47 — ring failure
- 81 — invalid call reference
- 96 — mandatory information element missing
- 97 — message unimplemented
- 99 — information element unimplemented
- 100 — invalid information element contents
- any — unspecified cause value (default)

**Channel tab** — Select the channel to be analyzed. For DDS channels, also select the DDS rate. For some terminate tests, specify that the transmit equals the receive.

**CLP** — ATM Profile tab. Cell Loss Priority.

- Tx Profile — Specify 0-1
- Rx Profile — Specify 0-1 or X

**Code tab** — Specify the line code as AMI or B8ZS.

**Constant (CBR)** — ATM Tx tab. Select to transmit constant bit rate traffic on your primary transmit profile.

**Cont Bndwth** — ATM Tx tab. Specify the bandwidth to transmit CBR on your primary and, if applicable, secondary transmit profile.

**Correlation Tag** — ATM Tx tab. Specify Default or User defined. If you select User, enter the correlation tag using hexadecimal notation.

**CRV** — Trace tab. To trace a specific call, select CRV and then enter the call's call reference value in the corresponding field. You can enter up to nine CRVs when you trace calls.

**CSU Loop Code** — Loop Code tab. Specify the code to be transmitted on the loopback.

- CSU
- ESF
- ESF Payload

**DDS Loop Code** — Loop Code tab. Specify the code to be transmitted on the loopback.

- LAT OCU
- LAT DSU
- LAT Channel
- LAT DS0-DP
- LAT NEI

**DS0** — Trace tab. To trace calls for a specific DS0, select DS0 and then select the arrow to the right of the field to enter the DS0 assignment for the calls.

**DS1** — Trace tab. To trace calls for a specific DS1, select DS1 and then select the arrow to the right of the field to enter the DS1 assignment for the calls.

**Error tab** — Specify the error to insert during testing. Enable "Beep on Error" and specify the insertion type.

**Error Type** — Error tab. Specify the error to insert during testing. The selected error appears as an action button. Select the action button to insert the error.

**Framing tab** — Specify the framing of the network being tested.

- Select **Unframed** if the network is not framed.
- Select **Auto** to auto-detect the type of framing on the network.

**GFC** — ATM Profile tab. Generic Flow Control. Does not apply to the NNI interface.

- Tx Profile — Specify 00-15.
- Rx Profile — Specify 00-15 or X.

**GR-303 tab** — Specify the filter value for the Service Access Point Identifier (SAPI) and the Terminal Endpoint Identifier (TEI). Also, specify the Cause Code (see Cause Code).

**HDSL Equipment tab** — Select the repeater model.

- Adtran HRE
- Adtran HTU-C
- Adtran HTU-R
- Pair Gain HDU
- Pair Gain HLU
- Pair Gain HRU

**Insertion Type** — Error tab. Specify how to insert the error.

- Single
- Rate
- Burst (Dur)

**Interface** — ATM Profile tab. Specify the network interface.

- UNI — User to Network Interface
- NNI — Network Node Interface

**ISDN tab** — Specify the switch (5ESS, DMS 100, or NI-2) and configure the TestPad ISDN interface.

- Single — Configure the primary interface and D channel only.
- NFAS Only — Configure the primary and secondary (interface only for secondary).
- NFAS/DCBU — Configure the primary and secondary interface and D channel.

**ISDN Call tab** — Select **Config Call 1** and **Config Call 2** to specify the call parameters. Select **Advanced** to specify the numbering type and plan.

**Loopback Type** — OAM tab. Select **VP-Loop** to format the OAM cells for a virtual path, or VC-Loop to format the cells for a virtual channel.

**Loop Code tab** — Specify the code to be transmitted on the loopback. Also, enable the TestPad to auto-respond to the return of the transmitted signal.

**MSS Setup tab —** Specify the MSS model and the card number.

**Negotiated PCR (cells/sec) —** ATM tab. Specify the negotiated peak cell rate established in the customer's service level agreement.

**NIU Loop Code —** Loop Code tab. Specify the code to be transmitted on the loopback.

- Facility 1
- Facility 2
- Facility 3
- ESF NET

**OAM tab —** Select the OAM type, Loopback type, and alarm type to transmit. The selected types appears as action buttons. Select the action button to insert the error.

**OAM Type —** OAM tab. Select **Segment** to transmit the OAM cells to the next network element in the path, or **Loopback** to transmit the cells to the last network element in the path.

**OH tab —** Manipulate the value of selected overhead bytes.

**Origination Source —** Trace tab. To trace calls originating from a central office or remote terminal, select **Origination Source**. and then select the arrow to the right of the field to select Central Office or Remote Terminal.

**Path Trace tab —** Select the trace message to be tested. Select **User** to create your own trace message.

**Pattern tab —** Specify the pattern to transmit.

**Peak Bndwth —** ATM Tx tab. Specify the sum of the CBR and VBR traffic to transmit on your primary transmit profile.

**Pointer tab —** Specify to increment or decrement the pointer by one. The selection appears as an action button on the main screen.

**Primary Tx Profile Cells —** ATM Tx tab. Specify the continuous bandwidth in percentage on the ATM Tx tab.

**Profile Selection —** ATM Profiles tab. Select the profile representing the ATM connection.

**Profile Settings —** ATM Profiles tab. Specify the VPI, VCI, GFC, PTI, and CLP values for each of the four user-defined profiles and the user-defined receive profile. After you define these profiles, they are available to select each time you perform an ATM test.

- In the Rx profile, all of the fields can be set to "X", which matches any value.
- When monitoring a virtual connection, GFC, PTI, and CLP are commonly set to "X".
- When monitoring a virtual path, the VCI can be set to "X".

**PTI —** Payload Type Identifier (ATM Profile tab).

- Tx Profile — Specify 0-7.
- Rx Profile — Specify 0-7 or X.

**Remove Traced Calls After —** Trace tab. To stop tracing each call after a specific interval of time, select the arrow to the right of the Remove Traced Call After field, and then select the interval.

**Repeater Command tab —** Select the repeater model and command.

**Rx Input tab —** Specify the receiver input signal compensation modes:

- Bridge — Bridge mode is used to connect the TestPad to T1 circuits during in-service tests whenever a resistor isolated access point is not available.
- Term — In terminate mode, the connection is made to the end of the line. The received signal will be terminated and compensated for cable loss.
- DSX Mon — In monitor mode, the receiver will terminate the signal, compensate the resistive attenuation suffered by the incoming signal, and also equalize any cable loss.

**SAPI Filter —** GR-303 tab. Select the SAPI for the GR-303 calls you are analyzing. For TMC or CSC channels, either 0 or 1 is a valid SAPI value. For EOC channels, 1 is the only valid SAPI value. The TestPad will monitor calls for any SAPI if you do not specify a filter parameter.

**Scramble —** ATM Profiles tab. Enables ATM scrambling. O.191 test cells are scrambled by default with a different algorithm. When transmitting O.191 cells with scrambling on, both scrambling algorithms will be performed on the cells.

**Secondary Tx Profile Cells —** ATM Tx tab. Specify the continuous bandwidth in percentage.

**Select Test —** VF tab. Select the type of VF test to perform.

- Tone — Specify the frequency (Hz) and tone level (dBm). If you select **User**, manually enter in the frequency and/or level.
- Sweep — Specify the start and stop frequency, and the tone level. Specify the step duration and size. Specify the tone sweep direction.

**Speaker tab —** (VF applications only) Specify the Speaker Drop Source: Primary, Secondary, or Both.

**Summary tab —** Gives a summary of the current test configuration. To change a field, select that specific setup tab.

**TEI Filter —** GR-303 tab. Select the TEI for the calls you are analyzing, and then select **OK** to return to the main screen. For TMC or CSC channels, 0 is the only valid value. For EOC channels, 0 through 11 are valid. The TestPad will monitor calls for any TEI if you do not specify a filter parameter.

**Timing tab —** Specify the timing.

- Internal — emulating central office equipment.
- Recovered (loop) — emulating customer premises equipment.
- External T1 Bits — using an external timing source as a clock. This signal should be connected to the DS1 secondary receiver.

**Tone tab —** Specify the frequency and level of the tone. Select User to customize the frequency and/or level.

**Trace tab —** Specify the filter criteria for tracing GR-303 calls. To specify an interval after which the TestPad will stop tracing calls (and display the next subset of calls meeting your filter criteria), select the interval from the Removed Traced Call after field.

**Trunk tab —** Specify the trunk type. If Loop Start or Ground Start is selected, you can specify the circuit equipment. Also, specify the address type.

**Tx LBO tab —** Transmit Line Build Out. Specify the level of cable loss:

- 0 dB
- -7 dB
- -15.0 dB
- -22.5 dB

**Tx Wavelength —** Wavelength tab. Specify the transmit wavelength for optical signals:

1310 nm

1550 nm

**User Loop Code —** Loop Code tab. Customize the code for each of the user programmable codes.

**Variable (VBR) —** ATM Tx tab. Select to transmit variable bit rate traffic on your primary transmit profile. If you select VBR, you must specify the peak bandwidth, burst length and burst gap for the VBR traffic.

V**CI —** ATM Profile tab. Virtual Container Identifier.

- Tx Profile — Specify 00000-65535
- Rx Profile — Specify 00000-65535 or X

**VF tab —** Select the type of test to perform. If testing a specific tone, specify the frequency and level. If performing a tone sweep, define the sweep fields.

**VPI —** ATM Profile tab. Virtual Path Identifier.

- Tx Profile — Specify 000–255
- Rx Profile — Specify 000–255 or X
- For NNI interfaces specify 0–4095

# Glossary

## Symbols/Numerics

**802.11b** — IEEE standard for wireless LANs. You can establish wireless LAN connections to the TestPad using an 802.11 PCMCIA card.

## A

**AC** — Alternating Current. An AC power adapter is supplied with the TestPad.

**ADM** — Add-drop multiplexer. A multiplexer capable of extracting and inserting lower-rate signals from a higher-rate multiplexed signal without completely de multiplexing the signal. In SONET, a device which can either insert or drop DS1, DS2, and DS3 channels or SONET signals into/from a SONET bit stream.

**AIS** — Alarm indication signal. An alarm transmitted downstream by a network element when a major alarm (for example LOF or LOS) is received from the upstream side.

**AMI** — Alternate mark inversion. Successive ones are alternately inverted.

**Analysis Rate** — The bit rate of the data stream being analyzed by the BERT engine. The analyzed data stream can be the full payload or a demultiplexed tributary from the line interface signal.

**APS** — Automatic protection switching. In SONET/SDH, the protocols which ensure a transition from working to standby lines in the event of equipment or facility failure. APS is controlled via the K1 and K2 bytes in the Section Overhead.

**ATM** — Asynchronous transfer mode. A communications transport technology that formats, multiplexes, cross-connects, and switches voice, video, and data traffic.

## B

**B8ZS** — Bipolar 8 zero substitution. For every seven consecutive zeros, B8ZS inserts two violations of the bipolar line encoding technique.

**BERT** — Bit error rate test. A known pattern of bits is transmitted, and errors received are counted to figure the BER. The Bit Error Rate test is used to measure transmission quality.

**BIP** — Bit interleaved parity. A field used to perform a parity check between network elements for error checking.

**BPV** — Bipolar violation. The presence of two consecutive 'one' bits of the same polarity

**Bridge** — A high impedance tap into an E-1 or T-1 circuit (where no monitor point access is provided) that does not disrupt the existing communication line.

## C

**CBR** — Constant bit rate. An ATM service which supports a constant rate to transport such services as video or voice.

**Cmsg** — C-message. Measures the noise (in dBrnC) weighted with a C-Message filter for voice-grade analysis.

**Cnotch** — C-message notch. Measures the noise (in dBrnC) against a weighted C-message filter.

**Controls** — Synonym for test configuration. Appears on the TestPad user interface.

**CRC** — Cyclic redundancy check. A process used to check the integrity of a block of data.

**CSU** — Channel service unit. A device to terminate a digital channel on a customer's premises.

**Curr** — Current.

## D

**DALY** — A stress pattern consisting of a framed 55 octet hex pattern used with framed T1 circuits without causing excess zeros.

**DB-9** — Standard 9-pin RS-232 serial port or connector. The Y cable supplied with the TestPad provides a DB-9 connector.

**DB-25** — 25-pin RS-232 serial port or connector.

**DDS** — Digital data system. An all digital service that provides terminal-to-computer and computer-to-computer data transmission.

**Dec** — Decrement.

**DHCP** — Dynamic Host Configuration Protocol. A communications protocol that assigns IP addresses dynamically as needed. Also supports static IP address assignment.

**DS1** — Digital signal level 1. 1.544 Mbps.

**DS3** — Digital signal level 3. 44.736 Mbps.

**DSX** — Digital system cross-connect frame.

**DTE** — Data Terminal Equipment. Port that serves as the data transmission source, data transmission destination, or both, for the purpose of sending or receiving data. The USB/Serial port of the TestPad is configured as a DTE port.

**DUT** — Device under test.

## E

**Err** — Error.

**Erred** — Errored.

**ESF** — Extended super frame. A T1 framing format consisting of 24 DS1 frames. ESF framing bits add the functionality of CRC-5 error detection, a facility datalink, and enhanced signaling capability.

**Ethernet** — A LAN protocol. If you purchase the Networking option, you can establish Ethernet connections from the TestPad to an Ethernet network or a laptop or PC using an Ethernet PCMCIA card and an Ethernet LAN or crossover cable.

## F

**FEAC** — Far-end alarm control. A channel in DS3 signals using the C-bit parity framing format that is used for sending alarms, status, and DS1 and DS3 loopback commands.

**FEBE** — Far end block error. An alarm signal transmitted from a network element receiving a signal containing framing or parity errors to the network element sending the errored signal.

**FT1** — Fractional T1. FT1 permits users to buy bandwidth in either 56 kbps or 64 kbps increments

**FTP** — File transfer protocol. Protocol used on LANs and the Internet to transfer files. If you purchase the Networking option, you can transfer files to and from the TestPad using FTP.

## G

**GR-303** — An interface used to concentrate large numbers of DS0 channels in DS1 facilities. The interface used dedicated DS0 channel to carry Operations, Administration, Maintenance, and Provisioning (OAM&P) and signaling information.

## H

**HBER** — High bit error ratio.

**HDSL** — High bit rate digital subscriber line.

**Histogram** — Print output of specific results in a bar graph format.

## I

**Inc** — Increment.

**IP** — Internet Protocol. Protocol specifying the format and address scheme of packets transmitted over the Internet. Typically used with TCP.

**ISDN** — Integrated service digital network. The addition of a local loop segment to an all digital common signaling and transport network.

**ISO** — International Organization for Standardization.

**ISP** — Internet service provider. A vendor who provides access to the Internet and the World Wide Web.

**ITU** — International Telecommunications Union based in Geneva, Switzerland.

## J

**Just** — Justification.

## L

**LBO** — Line build out. The level at which an output signal is transmitted, selectable at 0dB, -7.5dB, or 15dB.

**LCD** — Liquid crystal display.

**LED** — Light emitting diode.

**Line** — The layer in a SONET network that describes the region between two line-terminating pieces of equipment, typically add-drop multiplexers or terminal multiplexers.

**LOF** — Loss of frame. A condition indicating that the receiving equipment has lost frame delineation.

**LOP** — Loss of pointer. A condition indicating loss of a pointer to a virtual tributary.

**LOS** — Loss of signal. A condition indicating that the receiving equipment has lost the received signal.

**LPAC** — Loss of performance assessment capability. A condition indicating that cells that can be analyzed by the TestPad haven't been received for a period of 10 seconds. This condition is typically due to receipt of errored or non-masked cells.

## M

**M13** — A frame format used for multiplexing 28 DS1 signals into a single DS3. The multiplexer equivalent of T-1.

**Msg** — Message.

**Multipat** — Multiple patterns. An automated sequence of 5 BERT patterns for three minutes each. The Multipat sequence consists of ALL ONES, 1:7, 2 in 8, 3 in 24, and QRSS.

**Multiplex** — MUX. To transmit two or more signals over a single channel.

**Multiplexer** — Electronic equipment which allows two or more signals to pass over one communication circuit.

**MUX** — See Multiplex.

## N

**NDF** — New data flag.

**NFAS** — Non-facility-associated signaling. Signaling that is separated from the channel carrying the information. Also known as out-of-band signaling.

**NiMH** — Nickel-Metal Hydride. The TestPad is equipped with a rechargeable Nickel-Metal Hydride battery.

**NIU** — Network interface unit. Electronic device at the point of interconnection between the service provider communications facilities and terminal equipment at a subscriber's premises.

**NSA** — Non-service affecting.

## O

**OC-12** — Optical carrier 12. A SONET channel of 622.08 mbps.

**OC-3** — Optical carrier 3. A SONET channel equal to three DS3s (155.52 mbps).

**OC-48** — Optical Carrier 48. SONET channel of 2.488 Gbps.

## P

**Packet** — Bundle of data, configured for transmission. Consists of data to be transmitted and control information.

**Path** — The layer in SONET network that describes the region between two path-terminating pieces of equipment, typically terminal multiplexers.

**PCMCIA** — Personal Computer Memory Card International Association. The PCMCIA standardizes credit-card size packages for memory and input/output for computers, laptops, palmtops, and more.

**Pointer** — A value that alerts SONET equipment of the starting point of a floating synchronous payload envelope within a SONET frame.

**Print event trigger** — An event, such as a change in test results or a test restart, which prompts the TestPad to generate print output.

**Print mode** — The means of generating print output on the TestPad. You can manually generate output, schedule the TestPad to generate output at timed intervals, or schedule the TestPad to generate output when a test ends.

**Print type** — The type of information provided in print output.

**PSTN** — Public switched telephone network.

**Ptr** — See Pointer.

## Q

**QRSS** — Quasi-random sequence signal. A modified 2^20-1 pseudo random test signal, modified for use in AMI circuits.

## R

**RDI** — Remote defect indication. A signal transmitted in the outgoing direction when a terminal detects specific defects in the incoming signal.

**RJ-11** — Modular telephone jack, typically used for telephones, modems, and fax machines.

**RS-232** — Set of standards specifying electrical, functional and mechanical interfaces used for communicating between computers, terminals and modems.

**Rx** — Receive.

## S

**SA** — Service affecting.

**SDH** — Synchronous Data Hierarchy.

**Secs** — Seconds.

**Sect** — See Section.

**Section** — The layer in a SONET network that describes the region between two section -terminated pieces of equipment, typically regenerators, add-drop multiplexers, or terminal multiplexers.

**SES** — Severely errored seconds.

**SLC96** — Subscriber line carrier 96. A multiplexing device that allows up to 96 analog telephone customers to be served over a single four-wire digital circuit.

**SMTP** — Simple mail transfer protocol. You must connect to an SMTP server to send e-mail from the TestPad.

**SOH** — Section overhead.

**SONET** — Synchronous optical network.

**STS** — Synchronous transmit signal.

## T

**Tcl/Tk** — Scripting language which enables you to write your own test scripts for the TestPad.

**TCP** — Transmission Control Protocol. Protocol enabling two hosts to establish a connection and exchange streams of data.

**Term** — See Terminate

**Terminate** — An application where the test set is terminating the circuit. In these applications, the test set sends and receives traffic. An out-of-service BERT is a terminate application.

**Thru** — An application where the test set is used in series with a network circuit to monitor the traffic on that circuit.

**Tx** — Transmit

## U

**UIM** — User interface module.

**USB** — Universal Serial Bus. A bus designed to handle a broad range of devices, such as keyboards, mouses, printers, modems, and hubs. The Y cable supplied with the TestPad provides a USB connector.

## V

**VBR** — Variable bit rate. An ATM service which supports a variable rate to transport services such as voice.

**VCI** — Virtual channel identifier. In an ATM cell header, the address assigned to a virtual channel. Multiple virtual channels can be bundled in a virtual path.

**VDC** — Volts Direct Current.

**VF** — Voice frequency. An analog circuit that can carry voice or data, nominally between 300Hz to 3400Hz. In telephony, the bandwidth allocated for a single voice frequency channel is 4kHZ, including guard bands.

**VNC** — Virtual Network Computing. A thin client system that enables you to run applications on a VNC server from any other computer connected to the Internet. Using VNC, you can run the TestPad from a remote workstation, and you can run remote applications from the TestPad.

**VPI** — Virtual path identifier. An in ATM cell header, the address assigned to a virtual path. A virtual path consists of a bundle of virtual channels.

**VT** — A signal grouping used to transport signals smaller than DS3 within a SONET frame.

**VT1.5** — Virtual tributary. 1.5 equals 1.544 Mbps.

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